UNIVERSIDADE FEDERAL DE SANTA CATARINA PÓS-GRADUAÇÃO EM LETRAS/INGLÊS E LITERATURA CORRESPONDENTE

PERCEPTION AND PRODUCTION OF ENGLISH FINAL STOPS BY YOUNG BRAZILIAN EFL STUDENTS

por

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To
Jay (in memoriam)
Olga
Rita
Antonio
Bruno
with all my love and respect.

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ABSTRACT

PERCEPTION AND PRODUCTION OF ENGLISH FINAL STOPS BY YOUNG BRAZILIAN EFL STUDENTS

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2007

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This research focuses on the investigation of the perception and production of English final-stops by young Brazilian EFL students. It was reported the quantitative results of one AX discrimination, one imitation and one free-production test. The discussion of the tendencies of production as well as the relationship between perception and production tested the hypothesis of markedness degree in relation to voicing and place of articulation of the target phonemes. In addition, the correlation between the perceptual sensitivity of CVC syllable pattern and the ability to produce the final-stops in a target-like fashion was also analyzed in the present study. Twelve learners (mean age 5.2 years) in their 4 ½ semesters of L2 instruction were tested. Following Koerich (2002), the six stops were investigated in terms of markedness of the consonants by: (1) voicing of the final-stops, and (2) place of articulation. In addition, it was examined the markedness of the CVC syllabic pattern and the simplification strategies applied by this sample. The relationship between perception and production was assessed in terms of syllabic complexity (CVC versus CVC ○. The overall results revealed that the participants do apply simplification strategies to final-stops in CVC words. The voiced

stops were not more mispronounced than the voiceless targets and the bilabials seemed to be the only ones that, if not modified by epenthesis, followed the prediction concerning place of articulation. A positive correlation was found between the results from the imitation and the production tests, and not from the AX discrimination results.

104 pages (excluding appendix)
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RESUMO

PERCEPÇÃO E PRODUÇÃO DAS OBSTRUINTES FINAIS POR CRIANÇAS BRASILEIRAS ESTUDANTES DE INGLÊS

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2007

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Esta pesquisa tem o objetivo de investigar a percepção e a produção das obstruintes finais em palavras do inglês por crianças falantes do Português. Resultados quantitativos dos testes de percepção (AX), de imitação e de produção foram reportados conjuntamente com discussão sobre as tendências na produção e na relação entre produção e percepção, testando a hipótese da marcação em relação a vozeamento e ao ponto articulatório das consoantes-alvo, assim como a da correlação entre a percepção do padrão silábico CVC e a habilidade de produzir as obstruintes apropriadamente. Doze estudantes (M = 5 anos e 2 meses) em seu 4◦ semestre de instrução foram testados. Seguindo Koerich, 2002, as obstruintes foram investigadas em duas variáveis relacionadas à marcação das consoantes: (1) vozeamento das obstruintes e (2) ponto articulatório. Foram examinadas as estratégias de simplificação utilizadas pela população testada em relação à marcação do padrão silábico CVC. A relação entre percepção e produção foi verificada de acordo com o contraste entre CVC e CVC . Os resultados revelaram que os participantes fizeram uso de estratégias de simplificação nas obstruintes finais. As obstruintes vozeadas não mostraram mais erros de pronúncia do que as surdas e as labiais foram as

únicas que, quando não receberam a vogal epentética, seguiram a tendência em relação ao ponto articulatório. Foi verificada uma fraca correlação positiva apenas entre os resultados obtidos no teste de imitação e produção.

Nº de páginas: 104
Nº de palavras: 27485

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ABBREVIATIONS

AOL	Age of learning
BP	Brazilian-Portuguese
BP/E	Brazilian-Portuguese/English
CPH	Critical period Hypothesis
EFL	English as Foreign Language
FA	False alarm
Hit	Correct indication of the odd item out in the AX discrimination test
IL	Interlanguage
IPA	International Phonetic Alphabet
L1	Native language
L2	Foreign Language
MS	Mean Scores
MDH	Markedness Differential Hypothesis
SD	Standard Deviation
SLM	Speech learning Model

CONVENTIONS

V	=	vowel
C	=	consonant
CVC	=	a word constituted of consonant – vowel – consonant
CVCi	=	a word constituted of consonant – vowel – consonant with the extra vowel /i/ added in the end
[…]	=	phone
(…)	=	optional
⊃	=	implies

CHAPTER 1

INTRODUCTION

1.1 Background of the study

In the age of globalization it is essential to have knowledge about a foreign language if one is willing to achieve a broad perspective of the world. Having English become the *lingua franca* in global communication, the necessary international exchange of knowledge that fosters worldwide development becomes possible. As a consequence, people whose mother tongue (L1)[1] is not English have realized the need to learn the language, since it facilitates cultural and professional exchange.

Researchers investigating the processes of foreign language (L2) acquisition believe that, especially in the realm of pronunciation, adults tend to face more difficulty than children, and investigate differential facility to access universal grammar (UG) as a reason for that. If UG is no longer available after the "critical period" (Lenneberg 1967; Schachter 1988; Scovel 1988) happening around puberty, adults will access linguistic knowledge exclusively through L1, which in turn favors L1 transfer resulting in sound substitutions instead of the establishment of new categories for the L2 sounds.

Age-related effects on L2 acquisition have been traditionally investigated according to the notion of the Critical Period Hypothesis (CPH), which predicts loss of brain plasticity after puberty, predestining adults to fail in L2 acquisition, mainly in terms of

[1] L1 is used in this work for mother tongue, native language and any other equivalent terms, whereas L2 is used for terms meaning either foreign or second language.

sounds. The hypothesis does not go without questioning, though, and counter-evidence to a biological hindrance in L2 acquisition has fed interesting, however complex discussions. For instance, based on studies indicating that neural connections are sparse at birth, then are produced at a remarkable rate in infancy, reaching optimal density at the age of six, and decreasing thereafter, Vitti (2002) states that children are more predisposed to learning in the early years and, more specifically, up to the age of six, have a considerable advantage in acquiring an L2 in comparison to older children. Alternatives to biological limitations in acquiring an L2 are offered by researchers investigating the influence of psycholinguistic and psychosocial aspects (see Section 2.4).

Throughout my career as an English teacher for children, I have indeed noticed the learners' great interest and willingness to communicate orally in the language. I have also observed that, in their pronunciation, certain segments cause more difficulties than others, cause difficulties in certain word positions, and certain phonological environments. In general the difficulties young learners present are not different from those of older learners, validating generalizations about the difficulties in terms of L1 interference. In Brazil, the number of children studying English can be considered large, as the number of language schools in the country attests (according to the Brazilian magazine, Veja Educação, there were 3.345 English institutes in Brazil[2] in 2001); however, rarely are academic and scientific studies conducted on children's L2 acquisition, more specifically, on the acquisition of phonology with this age group. Due to this lack of research the present study had two general goals. First, it investigated the simplification strategies applied to final stops in English CVC words in the outputs of young Brazilian learners of English as a foreign language, at the beginning stage of

[2] http://veja.abril.uol.com.br/idade/educacao/140896/p_062.html

acquisition. Second, it investigated the perceptual sensitivity for the contrast CVC and CVC/ ĭʊ aiming at observing the type of relationship between the perception and production of the English final-stops by this group of participants. The ultimate goal of this study is to offer language experts, more specifically researchers and teachers of English for young Brazilian learners, empirical data on speech perception and production to be taken into consideration when conducting research in the area, as well as to support their actions in the classroom.

Up to date, scientific studies investigating L1 acquisition and the few studies investigating L2 perception and production conducted with infants and young learners, and more frequently with adults, have shown some common tendencies, supporting the hypotheses tested in the present study. For instance, regarding simplification strategies, studies have indicated that the preference for less complex sounds and units seems to be common in language learners' speech. (e.g. Yavas, 1994, 1997; Weinberger, 1997; Lamprecht, 2004). Some of these simplification strategies are (i) deletion of the final consonant or addition of an epenthetic vowel after the final consonant, so that CVC becomes either CV or CVCV; (ii) devoicing (Eckman, 1987); and (iii) replacing the target which has a marked place of articulation with a correspondent less marked sound (e.g., Yavas, 1994, 1997; Azevedo, 1994; Teixeira, 1995, cited in Lamprecht, 2004).

Regarding the relationship between perception and production, based on Flege (1995) and Koerich (2002), this study predicts that subjects who produce more mispronunciations fail more frequently to discriminate mispronunciations from the correct pronunciation of the word final-stops. Studies on this relationship are recent and involve high levels of methodological complexity, so that the discussion of the outcomes has to be careful in detecting probable interference of extraneous variables and the

comparison between studies has to take into account the specificities of the methodologies applied. In this sense, Beddor and Gottfried (1995) explain that there are specific variables in L2 speech perception research that might affect the outcomes. In relation to the participants' profile and language knowledge, they are (i) the participants' linguistic experience in the L1 and L2, and (ii) their age at the time of testing, as well as their age at the onset of learning. Researchers point out that when investigating the outcomes of speech perception and production individual differences are extremely relevant (Beddor and Gottfried, 1995).

In relation to the instrument and tasks, intervening variables may be (i) the type of stimulus, such as synthetic or natural speech sounds, and (ii) the degrees of difficulty and complexity of the tasks.

As mentioned above, Brazilian learners of English have difficulty pronouncing word-final stops (Baptista, 2001, Koerich, 2002). The syllable structure CVC, where the final consonant is a stop is not allowed in BP. Studies conducted with BP learners of English have shown epenthesis – addition of the vowel /i/ or the reduced vowel / / – to be the most common strategy used by Brazilians when pronouncing English final-stops (Baptista & Silva Filho, 1997; Koerich, 2002; Silveira, 2004). Baptista (2001) observes the importance of guiding BP learners of English towards awareness of the L2 sound system, overcoming the difficulty with final obstruents. As Koerich explains, "(…) BP speakers tend to make syllable-final obstruents pronounceable via the insertion of a vowel after them [usually /i/], bringing the sequence to the CV pattern characteristic of the L1" (2002). Baptista argues that "American English speakers pronounce final stops without releasing the closure (…). [and that] students may find it easier to avoid adding the extra vowel if they learn to do the same" (p. 226).

Since this research was conducted with young learners, it was reasoned that natural phonological processes used during the acquisition of the L1 would be found in their L2 speech. In this regard, devoicing and deletion of the target consonants were also expected to occur, since they are related to degree of markedness of stops. In addition, palatalization of alveolars was also considered once it is increasingly present in the production of alveolars in BP (Albano, 1999, 2001).

1.2. Statement of the problem

In the present study, the targets are voiced and voiceless final stops in CVC words followed by pause. The two languages in contact here have different syllabic systems and phonotactic rules in relation to permissible position of the stops: in BP these obstruents only occur in final position of written words borrowed from Latin (Mezzomo, 2004 cited in Lamprecht, 2004), whereas in English they are accepted not only in the written but also in the spoken form. According to universal markedness, CVC syllables are more marked than CV syllables (Greenberg, 1978). In addition, Eckman (1991) proposes that languages that accept stops in syllable final position are more complex than languages that do not allow them. When a speaker of language allowing only less complex syllable structures such as BP learns a more complex language with syllabic inventory such as English, it is common that simplification strategies occur. The most likely simplification strategies can be predicted by the nature of the first language; however, there are times in which the variation can be a universal tendency if they occur in the acquisition of the L1

(Yavas, 1994) or even an individual choice.

Apart from investigating the simplification strategies applied by the group of participants to the final stops, the present study follows the predictions investigated in Koerich (2002) regarding the production of the targets based on the predictions posted by Eckman (1987) in terms of voicing and place of articulation. In addition, still in line with Koerich's study and Flege's (1995) Speech Learning Model (SLM), this research investigated the type of relationship between perception and production in vowel epenthesis following the final stops.

Therefore, mispronunciations of word final-stops produced and perceived by young BP learners of English as a foreign language, taking part in an instructional environment were analyzed in this study. The structures selected to be investigated in this study are isolated English monosyllabic words (CVC) having the final stops as the target phonemes, as the voiceless stops in *cap, cat, book*; and the voiced ones in *tub, bed, bag* (see Appendix B for the complete list of words).

1.3 Significance of the study

It is based on these tendencies, presented in section 1.2, and due to the lack of empirical data regarding the interphonology of young BP learners of English that I, as a researcher, understand the need and importance of investigating the level of difficulty these learners present when producing and perceiving the English final-stops.

Studies conducted with adult Brazilian learners of English have shown that markedness relations affect the interphonology system (Baptista & Silva Filho, 1997; Koerich, 2002). Therefore, the role of markedness in the interphonology of the group of participants tested in the present study is of direct relevance. In addition, this study can promote discussion whether the main simplification strategy found in BP adults' interphonology (i.e., epenthesis) is also frequent with BP children. Furthermore, it is extremely relevant to mention that the young age of the participants is a factor of novelty in the area, so that this study can be said to be a pioneer in this aspect. The present study also attempts to promote insights about the differences and similarities between the characteristics in the adults' and children's BP/English interphonologies.

1.4 Organization of the thesis

This thesis is organized into 5 chapters. Chapter 2 presents an overview of the most pertinent literature to date and reviews previous studies. At first it brings Chomsky's theory of the Universal Grammar (UG). Then, it presents the concept of markedness relations in light of Eckman's Markedness Differencial Hypothesis (MDH) and in relation to simplification strategies applied to complex targets. In addition, it presents the role of age in the acquisition of L2 speech sounds. At last, the chapter offers detailed information on the relationship between perception and production of speech sounds, giving special attention to studies conducted with Brazilian Portuguese learners of English.

Chapter 3 brings the method used in this research, including a description of the

pilot study carried out before running the actual experiment, the research questions and hypotheses investigated here, and descriptions of the instrument and procedures for data collection and for data analysis. Chapter 4 reports the results obtained along with the discussion of the data gathered with reference to the research questions and hypotheses presented in the previous chapter. Chapter 5 offers theoretical and pedagogical implications, as well as limitations of the present study, followed by suggestions for further research.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

This chapter reviews the literature on theoretical aspects and data from experimental studies which set the field for the present study. Four main topics of interest are contemplated here. First, this chapter brings the issue of Chomsky's universal grammar (UG), discussing human language innateness; then, it focuses on the concept of markedness and markedness relations expressed in the MDH (Eckman, 1987), and on simplification strategies applied as remedial measures in dealing with difficult segments and problematic syllable structures. Third, the chapter looks at the issue of the role of age in L2 speech sounds acquisition, reviewing research on that; and lastly, the relationship between perception and production in the acquisition of the L2 sound system is explored and research is reviewed with special focus on studies involving Brazilian Portuguese learners of English.

2.2 The acquisition of the L2 phonological system: the role of UG

A considerable amount of research in the area of L2[3] acquisition/learning[4] has been motivated by Chomsky's proposal of a Universal Grammar – UG – (Cook, 1988). In brief terms, Chomky's theory claims that human beings are gifted with an innate knowledge of a set of principles which hold for every language and also a set of parameters which can vary from one language to another. This innate ability is possible owing to the operation of the language acquisition device (LAD), a special neurological mechanism in the human brain that facilitates language acquisition and development (Richards, Platt, & Platt, 1992). Within the UG framework, a principle, that is, "a language universal, is a statement that is true for all natural languages". Examples of principles are the facts that all "languages have nouns and verbs, and distinguish three persons, all sentences have a subject, and all spoken languages have consonants and vowels". The parameters, however, are language specific and are, in general, binary (involving yes or no situations). Concerning the principle that all languages have subjects, a related parameter determines that in a particular language sentence subjects are always overtly expressed, whereas in others they are not (or may not be). Another example of a parameter is the fact that some languages contain both oral and nasal vowels, and others contain only oral vowels.

[3] L2 is used here as a 'general' term, referring to second/foreign language. When referring specifically to the English of Brazilian learners involved in the present study the term should be read 'foreign language'.

[4] The term acquisition is used in this study referring to language gain in general, and to language gain in natural settings. The term learning will be used referring to language gain in instructional settings as it is the case of the Brazilian learners of English in the present study.

Concerning the domain of L2 acquisition, the role of UG is continuously under debate and has been studied according to three logical possibilities related to the influence of L1 and of age: the first point of view considers that L2 learners have access to UG in its entirety; this is the so-called Full-Access hypothesis. The second possibility proposes that L1 regulates access to UG, so that only those aspects of UG that are present in the L1 are accessed (Partial-Access hypothesis). The third possibility (the No-Access hypothesis) proposes that no aspect of UG is accessible to L2 learners (Cook, 1996; Gass, 1996; Silveira, 2004).

Expressing a recurrent idea about the role of L1 in L2 acquisition, Gass (1996) considers that although there has been evidence that UG plays a significant role in L2 acquisition, L1 has also shown to be of great influence. In fact, some research has indicated a certain level of interaction between both sources of influence, whereas other studies have proposed that one source overrules the other, and the question of why some language features are more prone to influence from one of the sources remains open for investigations.

The operation of universals in L2 speech learning at the segmental or phonotactic level is far from understood. Gass and Selinker (2001) state that whereas the nativist position claims that UG is fully active in setting L1 parameters, much debate is needed about the accessibility of UG in the programming of parameters in L2 acquisition. The empirical assumptions of Chomky's LAD (and of UG as a whole) are continuously challenged in the literature by authors who argue that language acquisition is not independent of cognitive development (e.g., Clark, 1973; Gass, 1997; McLaughlin, 1990).

It must be noted that although cognitive theory does not recognize any knowledge of language to be transmitted genetically in humans, it does work with the hypothesis that significant cognitive nonlinguistic origins of language, as the ability to develop intricate notions about the world may be inherited.

An important notion about language universals was introduced by Greenberg (1963), the notion of implicational universals which expresses relations among language properties in terms of relations of the type 'if X, then Y'. Implicational relations regulate the presence of certain properties in a language according to the condition that if a language has property X, then it also has property Y. However, the reverse condition is not necessarily true. For instance, two implicational universals state that if a language has front rounded vowels, then it also has back rounded vowels, and that the presence of voiced fricatives in a language implies the presence of voiceless fricatives, but not the other way round. In order for an implicational universal to make sense, there must also exist a language or languages which have neither property X nor property Y. In the case of the latter example, some languages do not have voiced and voiceless fricatives (Richards, et al., 1992; Trask, 1999).

Katamba (1989) explains that universals are the features or elements present in all primary languages and that they determine the degree of markedness of certain features to be acquired by contrasting the L1 and the L2. According to Lenneberg (1967), it seems reasonable to state that language universals are part of human cognition and that when investigating the acquisition L1 and L2 sounds implicational relations (markedness relations) should be taken into consideration. Regarding L2 studies, the role of these relations should be explored in contrasting and comparing the sound systems of

languages involved so as to reach a deeper understanding of the variations in the learner's interlanguage.

Concerning L1 acquisition, researchers have investigated the role of universals, contributing greatly with information on the types of sounds children produce and on the processes employed as simplification strategies, which characterize the relation between the adult model and the child replica (Macken & Ferguson, 1987). Based on Jakobson (1968) and on Stampe (1969), Kiparsky and Menn (1987) point out that the acquisition of the L1 phonetic repertoire takes place as a result of children's filtering of adult's speech and that the filter is a reflex of a universal hierarchy of features arranged under patterns (successive branchings). Kiparsky and Menn (1987) explain that this hierarchy regulates the child's acquisition of the L1 phonemic system, in that during the process of phonology acquisition "the child must master the phonetic repertoire of the language [and (…) learn] the phonological rules that represent the regularities governing the variation of its words and morphemes" (p. 23).

The authors consider that children face two distinct problems in learning phonology: In the early stages, they have limited phonetic capabilities, and later, they are faced with the cognitive problem of learning the abstract regularities of the phonological system in order to understand or speak the language. The underlying representations of the language sound system are stored under a system of rules, operating on phonological features. However, both systems are rather active, plastic and allow exceptions through addition and discarding of rules. In fact, it is through recognition of word identity and active internalization of some phonological rules that production becomes a possible task.

Weinberger (1994) adds that in the acquisition of L1 or L2 sounds the learner must

develop two independent types of linguistic knowledge. The first type is phonetic knowledge, related to the production and perception of speech sounds in terms of setting the proper articulatory parameters, the phonotactics at the segmental level, as well as the suprasegmental features of the language being acquired. The second type is functional knowledge, which is in the grammar domain. According to the author, the more global functional principles are independent from the phonetic abilities once there is evidence that adults make use of certain simplification measures that are different from those children use in the acquisition of their L1. Concerning the application of simplification strategies in phonological acquisition, Katamba (1989) considers that it is regulated by language universals.

Owing to the fact that human languages are subject to variations across languages and between individuals, it is quite hard to talk about universals in language development since individuals may follow different paths in the course of language learning. However, some patterns in language learning within and across languages have confirmed the universal tendencies mentioned before (Jakobson, 1941; Stamp, 1969; Smith, 1975). Macken and Ferguson (1987) mention that some of the errors language learners make are common across languages and across children while others are not. Studies on L1 phonological acquisition have raised a partial typology of processes present in children's speech, which are noticeable through their output variation. The authors' investigation focused on the acquisition of voicing in search of universals and explanations for variation and regularities in L2 data and concluded that "underlying the linguistic variation are regularities that appear to reflect a general process of rule formation (p. 5)". Due to the lack of uniformity found in the data collected with children in the course of L1 acquisition, indicating a great diversity of outputs and individual variation even when the

target language was the same, subsequent studies found the need to investigate this individual variation more deeply. Therefore, recent research has given attention to individual variation and has indicated that acquisition takes place through the interaction of the individual and the language by formulating hypotheses, and that complex systems are constructed with practice.

Macken and Ferguson state that learners try to systematize and create rules for the received input, organizing the sounds in different contexts by a phenomenon called "regularization", which individuals can make use in different ways. Regularization takes place by "the processing carried out by the child" which involves "forming, testing, and revising hypotheses" and derives from "the interaction of the learner and a patterned input" (p.16), rather than through automatic means. In other words, whenever language learners encounter challenging items they conscious or unconsciously try to apply rules in search of universals to help them overcome the novelty. Thus children's speech development should not be seen as monotonic in relation to adult speech, false hypotheses and overgeneralizations can interrupt or, at least slow down, the progress.

Within the phonology of a language, there are rules for organizing the sounds into syllables and words, as for example, rules that regulate what types of onsets and codas are allowed in a language. These rules work with the phonotactic properties of the language (Giggerich, 1992). Examples of phonotactic universals are the facts that all languages have syllables with an initial consonant, but not necessarily syllables without an initial consonant, and all languages have open syllables (syllables ending in a vowel), but not necessarily closed syllables (ending in a consonant). According to Roca and Johnson (1999), these universals may be expressed in the following implicational terms:

VC ⊃ CVC / V ⊃ CV, meaning that all languages that present the syllable structure VC, also present CVC and V, and CV.

Since implicational relations operate on phonotactic constraints causing them to vary from language to language, it is expected that L2 learners whose L1 presents a different implicational relation from that of the L2 may find difficulties in acquiring the L2 system. These relations will be explored in the following section.

2.3 The acquisition of the L2 phonological system: the role of markedness relations

As Katamba (1989) proposes, in L2 acquisition, markedness relations operate on language universals determining the degree of difficulty of some structures (language features) over others. Markedness is a property which distinguishes more basic, natural, and frequent linguistic forms (unmarked forms) from the marked forms, those which are less basic, natural, and frequent (Richards et.al., 1992; Trask, 1999). Following Greenberg's (1963) concept of implicational universals Eckman (1996, p. 198) explains the notion of implicational markedness which expresses conditions for the occurrence of forms in languages, as follows:

If the presence of a structure *p* in a language implies the presence of some other structure *q*, but the presence of *q* in some language does not imply the presence of *p*, then *p* is marked relative to q, and structure *q* is unmarked relative to structure *p*.

Concerning marked relations in terms of consonants, Chomsky and Halle (1968, in Richards et al., 1992) propose that / /, / /, / /, / /, and / / are the least marked consonants, since they appear in most languages of the world. Thus, taking the implicational relation expressed by Eckman, the presence of other consonants in a language implies the presence of these consonants.

In general terms, markedness relations regulate the order of acquisition of certain items in a language system. The first theory predicting order of acquisition of phonemes was presented in 1941 by the structuralist Jakobson. Some of his predictions are that (i) the order of acquisition takes place starting with the minimal consonant inventory (i.e., p > t > m > n); (ii) stops are acquired before nasals; (iii) voiceless consonants are acquired before voiced; and (iv) front consonants are acquired before back (Macken and Ferguson, 1997). His predictions have been tested in a vast range of languages and with individuals of different characteristics in order to prove validity and have had substantial empirical support in L1 and L2 acquisition, although some other orders have been observed.

According to Freitas (2004) quite a large number of studies investigating the acquisition of BP as L1 have corroborated Jakobson's prediction about the order of acquisition of the stops in relation to the nasals (e.g., Hernandorena, 1990; Lamprecht, 1990; Ilha, 1993; Rangel, 1998). However, there are exceptions, and these are attributed to the fact that the two classes of phonemes are the first ones acquired by BP speakers and that the investigations usually access learners who have already acquired both.

In relation to the acquisition of the voicing contrast, there is a huge number of research carried out in various languages, investigating the voicing contrast of stops (Macken, 1987). In general, these studies support Jakobson's (1941) universal

assumption of children's preference for voiceless unaspirated stops, a tendency which is thought to be explained by the fact that voiceless unaspirated stops are easier in terms of articulation. Macken and Barton (1980) observed this tendency with respect to the acquisition of English. The authors state that English-speaking children acquire the voicing contrast between 1;10 to 2;8 years whereas Spanish-speaking children acquire it after 4 years of age. Studies with speakers of BP show that voiceless stops are acquired before voiced stops, and that the voicing contrast is lastly acquired within the velars (Rangel, 1998, in Freitas, 2004).

Concerning place of articulation, empirical studies investigating the acquisition of BP as L1, have shown two possible orders of acquisition for the stops. Whereas some studies indicate that bilabials are acquired before alveolars, which are acquired before velars (e.g., Azevedo, 1994; Teixeira, 1985, in Freitas, 2004), others (e.g., Lamprecht, 1990) point out that the velar stops are possibly acquired concomitantly with bilabials, before alveolars.

Theories of L2 acquisition have been presented based on the comparison of the specificities of the languages in contact. For instance, the strong version of the Contrastive Analysis Hypothesis (CAH) posted in the 50s and 60s by Lado (1957) predicts that what is new to the learner will be difficult and what is similar between the systems will be easily acquired. However, due to the shortcomings of the CAH and its relative inability to predict certain types of error within interlanguages, Eckman (1987) proposed that there should be an incorporation of universal principles when hypothesizing about possible errors and interlanguage output variations in cross-language research. The author proposes that the comparison of the two languages in contact is not

sufficient to predict the "relative degree of difficulty" which should be independent of all languages, that is, it should be universal. In short, his proposal is based on the notions of typological markedness, which indicates the degree of difficulty, and implicational relations between the languages involved.

According to Eckman's (1987) Markedness Differential Hypothesis (MDH) the complexity of the L2 in relation to the L1 will establish the degree of difficulty the learner will face when acquiring the L2. The Markedness Differential Hypothesis (MDH) predicts that:

> "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)."

The most important claim of the MDH is that, even though there may be large differences between an L1 and an L2, only some of them will present difficulty for the L2 learner. The areas of greater difficulty can be predicted from markedness relations between the languages in contact. Whenever the learner faces a more marked item in the

L2, there is a tendency to resort to simplification strategies. Regarding phonological acquisition, these simplification strategies appear in the learners' interphonology as mispronunciations.

Based on Eckman (1987) and Yavas (1994, 1997), the influence of markedness in terms of place of articulation of final consonants has been studied in the production of English by Brazilian Portuguese speakers (Baptista & Silva Filho, 1997; Koerich, 2002). These studies have examined the implicational relation mentioned above, which, according to Yavas (1994) can be explained by the influence of speech aerodynamics on the production of these consonants, since there is a greater power of air pressure released when producing the velars in comparison to less air pressure released for the alveolars, and still less pressure for the production of the bilabials. According to Barbara Baptista (2004, personal communication), another possible explanation for the greater level of difficulty with velars might be the lesser salience of the vocal tract movements, which are further back than for the bilabials.

More specifically for voicing, Yavas (1987) predicts that English word-final voiced stops are difficult for L2 learners whose L1s do not allow them, as voiced consonants are marked. Regarding place of articulation, (Yavas, 1997) suggests that the presence of velars imply the presence of alveolars, and these imply the presence of bilabials, but the reverse is not true. Thus, bilabials are the least marked and velars are the most marked of the three positions.

Not only segments present hierarchies of markedness but also the syllable position in which they occur follows this principle. For instance, the stops are acquired first in syllable initial position, and subsequently in the syllable final position, which indicates

the degree of difficulty between these two positions (Greenberg, 1963).

In addition, Eckman (p.140; 1987) among others (i.e., Dinnsen & Eckman, 1978) relate the order of acquisition of voicing in relation to the position of the obstruent in the syllable. He argues that before acquiring voice contrast in word-final position, the learner will have to acquire this contrast first in the initial and medial positions because the word-final position is more marked, consequently more difficult, than the other positions respectively.

In the same line of Roca and Johnson`s (1999) statement of markedness relations of syllable structures mentioned above, Weinberger (1987) suggests that, "a language containing syllables of the type CVCC will necessarily contain CVC as well as CV syllables. The reverse is not true" (p.402). In addition, Tarone (1987, p. 78) argues that due to a "universal articulatory and perceptual unit" there is an articulatory tendency for the CV syllable to operate in all languages. In terms of speech sounds acquisition, it can be said that languages which do not allow marked patterns will be less marked, thus easier to acquire. Also, speakers of the less marked language will, according to universal markedness, have difficulty learning a more marked language.

In the process of acquisition of more marked properties, learners tend to avoid the more marked properties or to apply simplification measures. For instance, in early stages of PB acquisition there must occur general avoidance of complex sequences such as CVC (initial C not being homorganic with the final C), or application of simplification strategies such as reduplication (CVCV) or deletion (CV) giving preference to less marked open syllables. In L2 acquisition, L2 learners of an L1 without word-final consonants might resort to the same syllable simplification strategies to overcome the

difficulty in pronouncing the L2 final consonant (Baptista & Silva Filho, 1997; Koerich, 2002; Silveira, 2004).

2.3.1 The acquisition of the L2 phonological system: simplification strategies

Stampe's Natural Phonology relates language acquisition and universal processes (Stampe, 1969; Donegan & Stampe, 1979). It presents the idea that children have an innate dynamic system consisting of innate rules or "natural processes" which reflect some property of the articulator. When acquiring the L1 (typically between one and a half and four years of age), children's speech sounds are systematically related to the corresponding speech sounds produced by adults.

According to Stampe, in the course of language acquisition the child filters and simplifies adults' speech in their outputs by applying some natural processes. The child learns the rules of the adult system and the modifications they make are purely phonetic adjustments towards the target forms. In the early stages, when children avoid a target or produce a simpler form from the adult's model, they are actually inventing rules to simplify their task and be able to speak the target item. Three of the universal simplification strategies applied by children in the process of L1 speech sounds acquisition are consonant cluster reduction, 'frog' is pronounced as [fog], deletion, 'cat' is pronounced as [ca], and substitution, 'dad' is pronounced as [dat] (Smith, 1975).

Therefore, in order to master the phonology of a language the child is required to prevent the application of some of these processes, allowing only the ones permitted in

the language and restricting those which are not. The active selection of processes happens through the mechanisms of suppression, limitation and ordering. Systematic 'errors' in speech production as the ones mentioned above and also fronting, 'back' is pronounced as [bat], are due to phonological processes in operation (Oller, 1975; Ingram, 1979); however, as the application of these processes often conflict, different processes are possible to be applied in order to resolve a "problem".

Kiparsky and Menn (1987) propose that phonology acquisition is, since the earliest stages, a problem-solving activity and that the discoveries are made through experimentation guided by children's innate capacity of forming hypotheses and feedback towards the goal of speaking a language. The authors explain that children exclude different classes of outputs (those which represent difficulty to them) by a variety of means and the output eventually reflects the mean used to solve the problem. Moreover, in avoiding difficulty, there is also the possibility of over-generalization of some rules.

The processes that are common in L1 acquisition are thought to reflect universal tendencies and constraints of human speech perception and production. When these processes occur in L2 acquisition, it is as if the learner attempted to reach the target form, which is somehow different from their L1 form, by reactivating the processes which are no longer in use. In this sense, a number of studies have reported that L1 phonological acquisition patterns are much more similar to language universals than do L2 acquisition patterns (Weinberger, 1994; Major, 1987; Tarone, 1987). In L2 acquisition, in addition to developmental processes 'natural' in L1 acquisition, some processes are considered to be due to L1 transfer, reflecting the L1 phonological system or dialectal variation. In

addition, phonological processes which are neither developmental nor due to L1 transfer may occur and they represent universal or language-specific constraints operating differently than in L1 acquisition, or they may represent individual constraints leading the learner through different routes towards the L2 target.

Furthermore, if the learner has overcome a difficulty during L1 acquisition, the processes that helped mastering the problematic item is not expected to occur again. More specifically, it is believed that processes mastered in the L1 phonology acquisition, regardless of the language being acquired (e.g., substitution by fronting or stopping, and assimilation by consonant harmony and reduplication), do not usually occur in L2 phonology. If a recurrence happens, it is thought to be caused by L1 transfer (Stoel-Gammon & Dunn, 1985). Wode (1977, 1978) proposes that learners acquire L2 phonology "through the grid of their L1 system" and that L2 phonological and phonetic information is identified as either similar to that of the L1, when substitution processes tend to be applied, or as non-similar, when natural phonological processes operate. In both cases, learners resort to simplification strategies as a means of dealing with problematic language items.

In general there are two types of simplification strategies applied in phonological acquisition: phoneme simplification strategies, such as fronting, aspiration ('cat' becomes [ ]) and palatalization ('cat' becomes [ ]), and syllable simplification strategies such as deletion ('cat' becomes [ ]) and epenthesis ('cat' becomes [ ]).

Simplification strategies such as devoicing and fronting are frequent in many languages (Weinberger, 1987). As mentioned above, in L1 phonological acquisition mastery of an articulatory difficulty is expected to permanently prevent the application of

simplification strategies even in the process of L2 acquisition. On the other hand, features that have been incorporated as speech habits in the production of specific L1 sounds (as is the case of an allophonic variation allowed in the speakers' L1) can be easily transferred to the L2.

Following the universal markedness regarding the acquisition of voicing, studies have reported devoicing as a natural simplification measure in the course of acquisition of different L1s which allow both voiced and voiceless counterparts. Nevertheless, this simplification strategy is usually suppressed around the age of four years, when speakers master the articulatory challenges of producing them, and thus, it is not expected to appear in the interlanguage of L2 learners.

Yet, some pronunciation features can be transferred from the L1, causing L2 mispronunciations. In the case of Brazilian Portuguese palatalization of alveolars followed by the high front vowel [ ] is, according to Bettoni-Techio (2005), the most recurrent allophonic variation in the language. Although the correlation between palatalization in BP and in English was only weak, it was significant at .05 level. Although the results indicated that L1 palatalization was not a definitive influence in learners' production of final alveolar stops, they showed that lack of palatalization in L1 was a faithful predictor of the absence of the process in the L2.

The main findings of Bettoni-Techio's investigation with BP learners of English at the intermediate level of L2 proficiency in terms of occurrence of phoneme simplification strategies were (i) the most frequent strategy applied was aspiration, followed by palatalization; (ii) contrary to Yavas' (1994) findings, devoicing was rarely produced; (iii) the voiceless alveolar stop was significantly more susceptible to aspiration

and palatalization than its voiced counterpart; and (iv) learners who usually do not palatalize word-final ‘te’ and ‘de’ in BP, do not tend to palatalize final alveolar stops in English.

Regarding syllable simplification strategies, deletion of segments is one of the most common processes in child L1 acquisition. In addition, L1 learners tend to modify a complex syllable pattern to one leveled to their current ability by deleting the last consonant or by adding a vowel to it, the process of vowel epenthesis. These processes can occur in children’s speech during the acquisition of L1s which allow complex syllable codas. Concerning English as an L1, researchers have reported that epenthesis is extremely rare, at least in the first stages of acquisition (e.g., Eckman, 1997; Ingran, 1976; Kornfeld, 1971; Macken & Ferguson, 1983; Olmsted, 1971; Vihman, 1980). L2 studies, on the other hand, have indicated epenthesis to be a frequent strategy applied to English final stops in CVC structures by speakers of BP (e.g., Baptista & Silva Filho, 1997; Koerich, 2002; Silveira, 2004). Studies have also shown that L2 speakers tend to delete the last consonant (e.g., Eckman, 1981; Flege, 1988a, 1989; Weinberger, 1987).

Weinberger (1994) proposes that in the production of CVC syllables, although both final consonant deletion and vowel epenthesis simplify the syllabic structure, the strategies differ in that, whereas the latter preserves the underlying form allowing for the listener to recover the intended form, the former promotes “an unrecoverable derivation” (p. 288). In this sense, Vihman (1981) states that as a consequence of deletion, homonymous lexical items are common in child’s language in the very early stages of language learning causing frequent ambiguity. In Weinberger’s words, the recoverability principle “constrains the amount of ambiguity that results from a linguistic and [..] a phonological operation” (p.289). Whereas recoverable strategies applied in the production of CVC

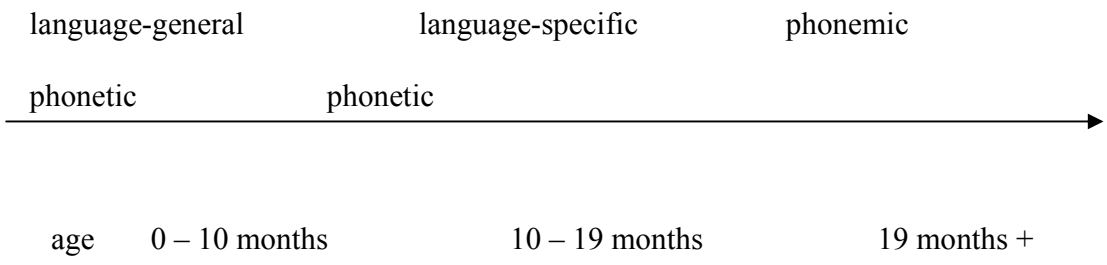
structures such as vowel epenthesis are prone to constrain ambiguity, unrecoverable ones such as final consonant deletion promote ambiguity.

In L1 acquisition, as soon as the recoverability principle becomes accessible, the learner starts using vowel epenthesis more often as a simplification strategy to make a distinction between the homonymous items (Weinberger, 1994). However, with the ability to produce more complex syllable patterns the use of epenthesis is extremely rare in normal children's native language. The recoverability principle matures with linguistic development, becoming available to learners and being triggered by linguistic input. The reason why the use of an epenthetic vowel is so frequently found in adults' early L2 language whereas deletion is rare (Tarone, 1980), might be that adults may have such a low level of phonetic domain, that they need to simplify the target structure; however since they have already acquired the recoverability principle, they resort to a recoverable structure and not to an unrecoverable one.

In sum, the role of epenthesis is related to the grammatical principle of recoverability. Due to the simultaneous development of the phonotactic skills and access to the recoverability principle, epenthesis is not usually found in normal L1 acquisition, however the availability of the recoverability principle is supposed to trigger epenthesis production, in order to avoid ambiguity. In contrast, empirical data shows that non-proficient L2 learners lack both functional and phonotactic knowledge as do disordered speech children, leading them to use simplification strategies in complex patterns. According to Weinberger (1994), "the prevalence of epenthesis in L2 phonological acquisition suggests that a subset of universal grammar is available to second language learners (…) as they have access to the principle of recoverability (p.300)." After all, this principle is not inaccessible to language learners.

2.4 The acquisition of the L2 phonological system: the role of age

Werker (1995) presents a model of speech perception adapted from Werker and Pegg (1992) which characterizes young infants as "language-general phonetic" perceivers, meaning that they have great sensitivity to phonetic contrasts independently of language. Between the 10th and 19th month, having consistent contact with a specific linguistic system, infants start organizing the speech sounds in terms of perceptual categories according to patterns detected in that system. Thus, the organization reflects "differential sensitivity to phonetic variability experienced (...), and the form of their perceptual categories conforms to the boundaries that specify phonemic contrast" (p. 158). Owing to the fact that the change from language-general to language-specific perceptual patterns happens together with the onset of word acquisition, around the first year of life, authors observe that it seems plausible that the change is a consequence of children's developing awareness of word meaning. Werker's model is represented in an age-line framework, as follows:



The implications of such a shift in speech sounds perception are that at the age of one, infants have already acquired much language-specific speech sound information, thus this information starts becoming part of their L1 group, and sensitivity to L2 sounds

begins to decline. In this sense, Kuhl and Iverson (1995) suggest that in relation to speech perception, infants are considered "citizens of the world" and adults "culture bound" (p. 121). As mentioned above, empirical findings support the thesis that with language experience listeners receive a large amount of L1 speech sounds exemplars, and become able to form categories for the sounds. This is the basis of Kuhl's Native Language Magnet (NLM) model (Kuhl, 1995), which proposes that the good exemplars are recognized as prototypes which form a closed perceptual system of the language. According to Jusczyk (1985, cited in Flege, 1995, p. 265) the process of L1 speech sounds acquisition culminates when children learn to read and start grouping allophonic variations to a single phonemic category. The author considers that before that, learners do not match allophones with a single phonemic category, since they rely entirely on sensory information to perceive the sounds.

Koerich (2002) and Scliar-Cabral (2004) review a number of studies providing evidence that the general linguistic abilities infants have to discriminate the phonetic differences of any language is gradually minimized in favor of the parameters of the language of immersion (L1). Among the oft cited works, the studies and reviews provided in Best & McRoberts (1989), Eimas, Siquelend, Jusczyk, and Vigorito (1971), Jusczyk, Hohne, and Mandel (1995), Kuhl (1993), Werker and Polka (1993), and Werker and Lalonde (1988) indicate that (i) the language experience infants have in the first months of life provides them with the tools necessary to discriminate phonetic features and phonotactic properties that constitute their L1; (ii) the phonotactic and prosodic features of the language are recognized by the infant, and as L1 acquisition progresses, are crucial for the storage of the lexical inventory of the language being acquired; (iii)

infants start losing their abilities to discriminate phonetic differences in any language from those of the language they are acquiring (L1) between nine to twelve months of age in average (authors do not totally agree about the onset of the loss); (iv) the main changes in L1 speech perception occur between the ages of two and six years; (v) by the age of 5 or 6 years children are usually fluent in the L1; (vi) like adults, children from 4 years old on show advantage in the perception of L1 over nonnative sounds; and (vii) young children are able to modify their perception of L2 contrasts in the course of L2 learning, whereas adults tend to resort to the acoustic parameters of similar contrasts in the L1.

Regarding the sixth item above, Werker (1995) reviews the studies of Polka, Jusczyk, and Rvachew (1995), Werker and Tees (1983, 1984a), Werker and Lalonde (1988), Best and McRoberts (1989), and Best (1993), among others, and concludes that the findings in research conducted with native English infants, older children and adults, regarding L2 speech perception of consonantal sounds lead to the thesis that up to 8 months of age infants are able to discriminate L2 consonant contrasts, whereas four, eight and twelve year-olds as well as adults have a poor ability to discriminate non-English consonant contrasts.

The last two items in the list above touch the issue of differential ability to acquire L2 speech sounds according to age. The discussion about the age a person is exposed to the L2 and its relation to the degree of native-like pronunciation is broadly raised in various studies. Theoreticians have put forward important framework to be considered when investigating such relationship. Lenneberg's (1967) Critical Period Hypothesis (CPH) often cited as the starting point for the discussion in scientific terms, posits that the critical period ends around the onset of puberty, beyond which mastery of a language (L1

or L2) is not possible due to loss of brain plasticity in the first place. The hypothesis proposes that the inability to acquire L2 owes to brain lateralization, a biological process in which different abilities are assigned to one or the other brain hemisphere.

Seliger (1978) and Walsh and Diller (1981) argue that there are many critical periods. Particularly in relation to pronunciation, they agree with Lenneberg and add that the first CP to be closed is the one that allows mastering an L2 native-like accent, taking place around puberty. Among other authors, Gass and Selinker (2001), Long (1990), Scovel (1988), and Weinberger (1994) consider that the CP is valid for pronunciation acquisition. In the words of Scovel pronunciation requires "neuromotor involvement" (articulation constrains). Weinberger suggests that "the critical period constrains only a subset of linguistic knowledge. It impedes specific phonetic and phonotactic abilities but does not affect the more global functional principles" (p. 285).

Authors who discuss the existence of a biological limitation related to age operating in the acquisition of speech sounds propose that individual characteristics may account for the fact that some adults succeed (e.g., Bongaerts, van Summeren, Planken & Schils, 1997; Flege, 1995, 1999; Seliger, 1972). Other authors believe that the process of lateralization affects the acquisition of the phonological system as a whole (e.g., Oyama, 1976) or affects specific levels of language, as for example, Scovel (1969), who proposes that the limitation operates at the articulatory and prosodic levels.

Although among other researchers, Flege (1988), Flege and Fletcher (1992), Flege, Munro, and MacKay (1995) have provided data indicating that earlier acquisition is 'ideal' in phonological terms, the biological foundations of a CP related to age have been criticized on a number of grounds. Authors offer explanations related to factors such as

"neurofunctional reorganization" influencing the retention of phonetic data in long-term memory, or to cognitive, psychological, or sociolinguistic factors (Flege, Munro, & MacKay, 1995).

Questioning the implications of perceptual changes to L2 sounds acquisition, Walley (2005) proposes that Jim Flege's research has provided data showing that "although sensitivity to foreign or non-native sounds may begin to wane in late infancy, the door for L2 learning is certainly not yet slammed shut!" (p. 2)

Although there has been research showing that adult L2 learners have difficulty in acquiring English vowels (e.g., Flege, 1992; Flege, MacKay, & Meador, 1999; Munro, 1993) these studies leave open the question whether age is the only factor, or the most important factor hindering acquisition (see Koerich, 2002) for a discussion).

The study conducted by Flege, Munro, & MacKay (1995) showed that age of L2 learning correlates with foreign accent. Flege, Munro, & MacKay (1995) investigated 240 L1 Italian learners of English who had initiated contact with the L2 between the ages of 3 and 21 years, and were living in Canada for over 30 years, on average. In this study as in others of the same line, although the results presented correlation between age of learning and degree of foreign accent, there was not a clear-cut around adolescence as proposed by the CPH (in fact there was no such data at any other age), and there was not a well-defined decline after that. Instead, in general, the results show a linear decrease in accuracy with age of learning. About the difficulty to isolate age as the decisive influence on L2 speech sounds acquisition, and the consequent difficulty to test the CPH with precision, Flege (1997) remarks that a number of variables in the studies may interfere with the data such as motivation towards acquiring a native-like pronunciation, as for example, when the learner develops emotional connection with the L2 community, and

length of contact with the L2. Additionally, these studies also show that some adults manage to achieve high levels of accuracy, giving evidence for the necessity of looking carefully at individual data.

One of the main claims of Flege's Speech Learning Model – SLM – (1995) is that the determining cause of adults' difficulties in acquiring L2 speech sounds is the stabilization of L1 parameters, deeply rooted by long immersion in a monolingual environment. As mentioned above, Jusczyk (1985, cited in Flege, 1995, p. 265) proposes that the stabilization of L1 phonetic patterns happens at the age of 5 or 6 years, when children begin learning to read. Flege (1995, and elsewhere) proposes that the main cause of accent is that learners tend to perceive L2 sounds based on the L1 phonological inventory. Therefore, the more developed the L1 system, that is, the longer the immersion in a monolingual environment, the greater the probability of accented speech.

Counter-evidence, or at least evidence to question the biological foundations of L2 difficulties proposed by the CPH are provided by recent studies using technological advances as functional magnetic resonance imaging (e.g., Wang, Sereno, Jongman, & Hirsch, 2000, 2003). These studies, among a number of others, have provided evidence of brain plasticity in L2 speech sounds acquisition, and in a not far future they tend to add fascinating data to the discussion of L2 acquisition age-related limitations, helping to understand why and how people of different ages succeed in acquiring native-like pronunciation, and others do not.

2.5 L2 speech perception and production

Speech perception is conceptualized as a decoding activity in which the listener extracts linguistic data from the auditory input (Trask, 1996). It has been put forward that the study of the relationship between L2 sounds perception and production has generated data in three different directions (Flege, 1995; Koerich, 2002). The first one is that perception outperforms production; the second is that the two abilities develop concomitantly, and the last is that production outperforms perception[5] (see Koerich, 2002 for a review). The first view seems to be quite reasonable and natural to occur if we take into consideration the process of L1 acquisition. It takes some time of language exposure before infants are able to produce speech. In addition, studies have shown that very young children are able to identify and discriminate some features of speech sounds prior to being able to actually produce them (see Section 2.4).

Several studies have investigated the relationship between the two abilities concerning L2 vowels (e.g., Bohn & Flege, 1989; Flege, 1993; Flege, Mackay & Meador, 1999; Flege, Bohn & Jang, 1997). Overall, although modest, some correlation was found between production and perception abilities, and some studies indicated perception to precede production. Another growing body of research has investigated consonants. Some of the studies showed a close link between the abilities (e.g, Flege & Schmidt, 1995; Bradlow, Akahame-Yamada, Pisoni, & Tohkura, 1999; Newman, 1998), whereas others offer data showing that production outperforms perception (e.g, Sheldon & Strange, 1982; Gass, 1984).

[5] The present study focuses on the first view.

Three models have provided insights about the nature of the processes involved in L2 speech perception. Firstly, according to Kuhl and Iverson (1995) the Perceptual Magnet Effect (PME) is a phenomenon which influences L2 speech perception and production since learners had had L1 experience prior to the L2. This view assumes that individuals establish phonetic categories – prototypes – in the perception and production of the L1 sounds, and when confronted with the sounds of another language they tend to relate these sounds to the L1 prototypes. The PME implies that L2 learners "choose" an L1 phonetic category to relate an L2 sound in order to make sense of it. Studies of Kuhl (e.g., Kuhl, 1991a, in Kuhl, 1995) conducted with infants and adults have showed the influence of the magnet effect (see Section 2.4).

Secondly, in the view of Best (1995) the perception of non-native segments involves the perception of gestural elements or intergestural phasing which do not match precisely any native constellations (native categories). Thus, from the point of view of Best's perceptual assimilation model (PAM), non-native segments tend to be perceived according to their similarities to, and discrepancies from, the L1 segmental categories that are in closest proximity to them in L1 phonological space. Thus, listeners assimilate non-native phones to native phonological categories. According to the author there are three possible patterns of perception when an L2 segment is assimilated to an L1 category: (1) the L2 can be assimilated to an existing L1 category – the English final [t] is assimilated to the BP initial [t]; (2) it can fall into a space in between L1 categories – the English final [t] in between the BP initial [t] and [d]; or (3) it can be assimilated to a non-speech category – the English final [t] is not assimilated to any of the BP phonemes.

The PAM is based on two assumptions: The first is that language-general perception gradually becomes language-specific by detecting the phonological inventory

of the language of exposure through gestural cues (articulatory cues) specified by higher-order invariants that are the articulatory features characterizing one specific language. The second assumption is that the information contained in these higher-order invariants is more compact (reduced) than those of simple gestural features that perceivers were able to detect before they could recognize patterns in the input. In relation to perceptual tuning to the native language, Best (1995) suggests that speech perception involves detecting distinctive features of the stimulus (auditory input) and passing over irrelevant differences. This gestural model assumes that the construction of phonological patterns is constrained by the physical structure of the vocal tract and the movements that its biomechanical components afford.

In the same line of thought, Flege's Speech Learning Model – SLM – (1995) accounts for the influence of L1 in the perception and production of L2 phonetic segments. The main proposition of the model is that establishing L2 categories becomes increasingly difficult as the phonetic space becomes tuned to the L1. Thus the model operates on the proposition that learners tend to interpret L2 sounds through the parameters of their L1 phonetic system. In terms of the role of age, the model "aims to account for age-related limits on the ability to produce L2 vowels and consonants in a native-like fashion" (Flege, 1995, p. 237).

Referring to the idea of prototypes of Kuhl and Iverson (1995), Koerich (2002) explains that the SLM proposes that "perception and production of L2 phones is mediated by the association of these phones to phonetic prototypes established as the ideal members of L1 categories" (p. 88).

The first hypothesis of Flege's SLM is particularly important for the investigation of the production and perception of word-final consonants. Flege proposes that "sounds

in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level, rather than at a more abstract phonemic level" (p. 239). In other words, speakers of a language which does not allow word-final stops, such as Brazilian Portuguese, will not relate English word-final stops to neither of the other positions the stops can occupy in the L1. Thus these speakers will eventually perceive and produce English word-final stops accurately once their L1 will not interfere in the establishment of a new phonetic category.

Based on the SLM, it can be expected that for the establishment of L2 categories learners should engage in the same process of sound perception that children do when acquiring the L1. This means that learners should focus on subtle differences between sounds which will allow them to categorize the L2 sounds. Some L2 sounds may be at first identified as allophonic variations of one category established in the L1, but as learners gain experience in the L2 they start gradually discerning the phonetic differences, leading to the establishment of a new category. As explained by Flege (1995) "the greater the perceived distance of an L2 sound from the closest L1 sound, the more likely it is that a separate category will be established for the L2 sound (p. 264)", and the earlier L2 learning commences, the smaller the perceived phonetic distance needed to trigger L2 category formation. Thus, according to the author, age of learning (AOL) and perceived phonetic distance between an L1 and an L2 sound are two important variables for the attainment of native-like pronunciation (see Section 2.4).

It must be noted that the SLM was not projected to deal with issues about the beginning steps pf L2 speech sounds acquisition, but with ultimate attainment, that is, the end state of acquisition.

The three models briefly reviewed above have set the field for many studies on the relationship between L2 speech sounds perception and production. Studies on the relationship gain importance as studies on perception of L2 sounds indicate that accented speech might be greatly caused by misperception of these sounds (Flege, 1995). The notion of a *perceptual foreign accent* was introduced by Strange (1995) accounting for learners tendency to use the L1 sound system as the reference to interpret the L2 sounds.

Flege (1999) remarks that, as hypothesized in the SLM, L2 segmental perception and production do not develop concomitantly as in L1 acquisition; however, research indicates that in the case of advanced learners, the two abilities seem to match to a certain extent, since the correlations are, in fact modest.

Very recently the interest in Brazilian speakers' performance in terms of the relationship between L2-English perception and production has triggered the following research: (i) Koerich (2002) investigated word-final consonants with 17 to 46 year olds, students at the beginning level and found statistically significant results for the link between the two abilities; (ii) Silveira (2004) also investigated beginner students and also found a significant correlation between perception and production post tests taken after a period of training; (iii) Rauber, Escudero, Bion and Baptista (2005) investigated 8 vowel contrasts with advanced L2-English learners and found evidence for a relationship between perception and production, with perception preceding production; (iv) Bion, Escudero, Rauber, and Baptista (2006) examined front vowels with proficient learners, and as in the previous study the results provided evidence for perception and production to relate, and for perception to precede production; (v) Rauber (2006) further investigated perception and production of English vowels with highly proficient learners who had never lived in an English-speaking country. Her results indicated that Brazilians have

difficulty in both producing and perceiving three English target pairs ďĭ ĭĕĭ ĭư ĭ ĭĕĭ ĭưĭ ĭĕĭ ĭơư giving evidence of some relationship between perception and production, since the pairs which were better perceived were also produced more accurately, and evidence for the fact that L2 perception precedes L2 production; and finally (vi) Frese (2006) investigated perception and production of *-ed* endings and found a highly significant positive correlation between the two abilities.

Although the results of studies on the relationship between perception and production show that there is some correlation, in general they are not strong. According to Flege (1999) possible explanations for the modest correlations may be given, among other factors, in terms of the lack of uniformity in the methodological aspects, and the remarkable degree of individual variation in different research programs (see Koerich, 2002, for a more extended explanation).

2.6 Conclusion

This chapter addressed the issue of Chomsky's universal grammar (UG) theory claiming that human beings are endowed with an innate knowledge of a set of language principles and parameters by the operation of the language acquisition device (LAD), a neurological system which facilitates language acquisition and development. Concerning L2 acquisition, it was discussed that, although there has been evidence for UG to play a significant role in L2 acquisition, research has indicated a certain level of interaction between the influence of UG and of L1, and the question of why some language features

are more prone to influence from one source or the other remains open for investigations. Then the chapter looked at the effect of markedness relations on L2 phonological acquisition, with special attention to markedness relationships which are expected to affect the production of English final consonants by BP L2-English learners. In this sense, according to the MDH (Eckman, 1987) the more marked English syllabic structure is expected to cause difficulties for speakers whose phonological system is molded on less marked structures as BP. Concerning the different syllabic structures of BP and English, the issue of simplification strategies applied as remedial measures in dealing with L2 difficulties was explored, with focus on the strategies expected and reported to be applied in the production of English CVC structures by BP speakers. Following that, the chapter explored the issue of age-related constraints on L2 pronunciation acquisition, traditionally posited in terms of the CPH, and more recently discussed under the scope of research using technological advances. The research reviewed indicates that very frequently, it is not possible to isolate age as the only factor of interference on L2 phonological acquisition, and researchers relate the results to other two main variables – amount of L2 experience and degree of use of the L1, since the studies have been mostly conducted in L2 environments. Alternatives to the CPH are offered in terms of proposals that learning to read, which in general happens at the age of 5 or 6 years, promotes stabilization of L1 phonetic patterns and may prevent L2 learners from perceiving and producing L2 sounds independently of the L1 phonological system.

The last issue explored in this chapter was the relationship between L2 sounds perception and production. Three models of speech perception were briefly reviewed – Kuhl's perceptual magnet effect, Best's PAM, and Flege's SLM. Then, studies on the relationship were reviewed. Overall, these studies indicate that the two abilities correlate,

although moderately.

Nevertheless, the information presented in this chapter offers not only the theory which permeated the present study, providing models of language learning, some tendencies about language universals and the most common speech variations found in the speech of language learners up to date, but also the results of some previous studies, which guided the formulation of the hypothesis tested here. In addition, this chapter aimed at supporting the discussion of the results obtained in the present study.

CHAPTER 3

METHOD

3.1 Introduction

This chapter describes the pilot study carried out with the aim of identifying the variables which should be investigated in the present research. These variables were defined according to the speech variations occurring in the outputs of the participants involved as described below. Besides being important for the definition of the variables, the pilot study was also essential in testing the materials and procedures for the data collection. Following the description of the pilot, the chapter presents the four research questions and respective hypotheses investigated in the study itself. Questions 1, 2 and 3 refer to the production of English final-stops and question 4 refers to the relationship between the production and perception of the six targets in CVC words. Finally, the chapter describes the experiment carried out, providing information about the participants' profile, the instruments, and the procedures adopted to collect the data, as well as the steps taken in the data analysis.

3.2 Pilot study

Only production was tested in the pilot study, which consisted of two tasks: an imitation task and a picture-naming task. Since perception tests are usually quite specific and can take long, it was reasoned that the results from the imitation task would provide insights about perceptual difficulties to be investigated in the subsequent research. The data of the pilot study was collected in the same language school where the participants of the research were tested.

Regarding the definition of the participants' profile, the observed aspects were minimum age and time of instruction (L2 exposure). The guiding idea was to choose the youngest learners possible with the required vocabulary knowledge of English and capacity to perform the tasks. It has to be mentioned that in face of the participants' age, and consequent cognitive maturity, special care was taken in selecting appropriate materials and procedures.

As mentioned above, the pilot study guided the decisions about the details of the present study. It can be said that, above all, this preliminary study was crucial once it indicated the most frequent mispronunciations of the final stops in CVC words by young learners of English. The mispronunciations detected in the pilot established the variations to be tested in the production and perception tests.

3.2.1 Objectives of the pilot study

Apart from improving aspects of the methodology, the objective of the pilot study was to investigate which language tokens would be included in the subsequent study. This selection took into consideration that the study aimed at investigating the influence of voicing and place of articulation of the final consonant in the CVC structure in order to add for the discussion about the most difficult sounds among English stops, and the most recurrent simplification strategy used by Brazilian Portuguese learners of English.

The results of the pilot were essential to defining the type of variation to be tested in the perception test. Due to the complexity of the perception test for this age group and in order to be able to cross perception and production data only epenthesis was tested in perception, since it was highly recurrent. After having this valuable information, the researcher was able to cross perceptual sensitivity of CVC vs. CVC words with the ability to produce CVC words. Seven aspects concerning the methodology adopted in the pilot study were investigated: (1) the words to be included in the production tests (imitation and picture-naming), more specifically, the CVC words ending in English stops which could be easily matched with pictures and named by the participants; (2) the number of tokens to be included in the tasks, considering the amount of data needed for the analysis, and the participants' propensity to hold attention; (3) the complexity and length of the perception and production tasks, considering the necessity to gather substantial data for the analysis; (4) the type of stimuli to be used, that is, spontaneous or recorded speech, considering the possibility of biased responses; (5) the recording tools

appropriate to save the data for instrumental analysis and to generate a backup; (6) the type of tasks which showed to be most reliable and age-appropriate; and (7) the most frequent speech variation, that is, the most recurrent mispronunciation, to investigate a possible correlation between perception and production.

3.2.2 Materials and procedures of the pilot

The participants in the pilot study were divided into three groups according to age and time of instruction in the L2. The mean age of Group A was 5 years and 2 months and these children had been learning English for 4 semesters at the data collection time. Group B's mean age was 7 years and 1 month and they had been learning English for 8 semesters. Group C's mean age was 8 years and 5 months and they had been learning English for 10 semesters. Having different age groups in the pilot study indicated the specificities of each age group, since the children were in different stages of physical, emotional and intellectual development.

The production tasks were designed by the researcher based on regular classroom activities that are used for teaching new words and for assessing vocabulary knowledge. First, the imitation task was a listen and repeat activity, in which the researcher showed a picture card saying the name of what was depicted, and the participant immediately repeated the word. Then, the picture-naming task consisted of showing the picture and having the participants naming it without auditory input. A set of 16 pictures representing the target vocabulary was carefully selected considering the learners´ familiarity with what was depicted and their ability to name it in the L2 (decoding the image and knowing

the word and how to produce it). There were three pictures representing each of the alveolar sounds (*cat, hat* and *foot*, for ˈɪ /; *red, dad* and *bed*, for /d/*)* and the velars (*book, duck* and *sock*, for / /; *bag, dog* and *pig*, for / /), and only two pictures representing each of the bilabials (*sheep* and *cap*, for / /; *cub* and *tub*, for / /) because there were fewer words ending with the bilabials in the participants lexicon.

The participants met the researcher during their class time in the foreign language school, and were tested individually. The data collection sessions followed a specific organization: First, the researcher asked the child's name and age and explained the steps of the tasks, in the mother tongue. The tasks were presented to the participants as a game in order to motivate them to participate and to promote a more natural (classroom-like) environment for the data collection, thus eliciting more spontaneous responses. The pictures were shown in a randomized order so that each participant was presented to a different order. The sessions were recorded using a Sony Mini Disk recorder (MZ-R70) with a multidirectional microphone. The total duration of both tests, that is the imitation and the picture-naming task, did not exceed three minutes and all the participants showed great willingness to perform the tasks.

The imitation task was run first and it was included for two reasons: First to introduce the vocabulary, the pictures, and the type of task to the participants, and second, because the outcomes would guide the design of the perception test to be applied in the subsequent experiment since imitation tasks have been used by some researchers to collect data about auditory perception (e.g., Diehl, MacCusker, & Chapman, 1981, all cited in Beddor & Gottfried, 1995, p. 221; Flege & Hammond, 1982; Nemser, 1971; Rochet, 1994). One advantage would be that it reduces the listener's memory load; however, Beddor and Gottfried (1995) add that the disadvantage of testing perception

through imitation tests is that "they do not distinguish between subjects' perceptual and articulatory abilities" (p. 221).

As soon as the participant was ready to start, the researcher flipped the picture cards one at a time saying the correspondent words, which were repeated by the participant. This session of the pilot was audio recorded and allowed for detecting aspects to be taken into account in the design and planning of the perception task to be adopted in the experiment.

The production test was carried out subsequently to the imitation task with each participant. The participants had to name the same pictures presented in the imitation task, but no auditory input was given this time. Each participant saw and named the sequence of pictures twice, again one at a time, as the researcher flipped the cards. The pictures were shown twice in order to increase the number of tokens gathered since the number of words used in the test was limited owing to the participants' vocabulary limitations.

The productions were analyzed in light of the MDH predictions in relation to syllable structure, voicing and place of articulation, concerning the production of final stops in monosyllabic words. In addition, studies investigating children's speech variation and the use of simplification strategies in certain stages of language development also enlightened the analysis of the data. The researcher analyzed the data by auditory judgment and transcriptions using the International Phonetic Alphabet (IPA), and by the use of the software for acoustic analysis Praat 4.2.18. The transcriptions of the utterances were classified and analyzed in terms of (a) use of syllable simplification strategies (epenthesis and deletion of the final consonant); (b) voicing or devoicing of the targets; and (c) mispronunciations that could be related to place of articulation (fronting or

backing). Palatalization and aspiration of the targets were not considered as mispronunciations in the pilot study since they did not interfere with syllable structure, neither indicated mistaken perception or production of the target, as it is the case of devoicing. They were considered as allophonic variations that could be due to dialectal reasons, since in BP they are in complementary distribution (Bettoni-Techio & Koerich, 2006).

3.2.3 Results of the pilot study and remarks

Concerning the methodology used in the pilot, it was observed that although the tasks (imitation and picture-naming) were appropriate to be used with even the youngest participants, and that all participants showed interest in performing them, there were a few aspects to be modified in the study. First, the number of speech samples of English stops should be increased (the total number of speech samples gathered in the pilot study was 144; that is, 16 per participant). Since the goal was to find tendencies in the participants' speech, and great individual variations were observed in the dataset of the pilot, it was reasoned that increasing the number of tokens would enable collecting more speech samples, which would provide more data to investigate possible tendencies. Thus, it was decided that each stop would be tested in four different words. On the other hand, increasing the vocabulary caused more difficulty for the participants because they did not know some of the words included in the tests. Even though there were a few new words, since most of these words were part of the participants' vocabulary and could be easily represented in pictures, it was decided to include them in order to more data to

investigate.

Second, the use of spontaneous speech as the input in the imitation task did not show to be appropriate. It was observed that the talker (the researcher) slightly emphasized the word endings, probably unintentionally attempting to call the participants' attention to the ending sound, and this emphasis made the speech sound unnatural. Hence, in the subsequent experiment, a native speaker completely naïve about the objectives of the experiment, recorded the input to be presented to the participants.

Third, both tasks (imitation and picture-naming) showed to be appropriate to the participants' profile, as well as for the data collection and, as it had been reasoned, the results indicated that the perception test should last only a few minutes, since the participants did not seem to hold attention for long, and the degree of complexity should be the least possible, that is, involving only the discrimination of two speech samples. Accounting for these requirements, it was decided to use an AX discrimination task in the perception test. In order to limit the number of trials, the velar phonemes were chosen to be tested in the perception investigation for two main reasons. Firstly, because the results of the production in the pilot showed that they caused great difficulty since the participants did not have sufficient vocabulary knowledge and had difficulty naming the pictures by themselves, and secondly, because, as mentioned in Chapter 2, previous research has shown that these phonemes are in general the ones acquired later in the language development and because they are universally more marked than bilabials or alveolars. In this sense, the velar stops seemed to be of great relevance to be investigated more deeply.

Fourth, traces of the accent in the native language seemed to have interfered mainly in the pronunciation of the older children (8 year olds), since some of the

consonants produced resembled specific accents in BP. For instance, if a participant spontaneously palatalizes the /t/ in their native speech s/he (in most of the cases) palatalizes instances of final /t/ in English, or if the final vowel after the /t/ is produced as /e/ as in *leite* – 'milk' – s/he also produces 'cat' as [k e].

Fifth, this fact could be due to the influence of L1 literacy acquisition. Since when BP speakers learn to read and write instruction and practice is given syllabically (beginning from the CV pattern, since, it is the most common in BP), when they faced a CVC unit they may have transferred their preference for CV, rejecting the stops in final position. According to Flege (1996) and Pennington (1998), among other authors, learning the graphic representation of speech favors grapheme-phoneme associations and may provoke interference in the acquisition of pronunciation, especially in a cross-language situation. Werker and Polka (1993) advocate that about the age of 5 years children have their perception and production of speech sounds closer to adults' patterns[6], so L1 knowledge may somehow filter the acquisition of L2 speech sounds, affecting both abilities. In order to avoid the interference of literacy as an additional variable in the investigation, and to focus on a homogeneous group of participants, it was decided to include only pre-literate children between 4 and 6 years with at least three semesters of English instruction in the experiment.

Sixth, the Mini Disk recorder showed to be appropriate for recording the participants' voice with high quality. However, since there was much background noise in the recordings of the pilot, in the subsequent experiment, the multidirectional microphone was replaced by a microphone placed closer to the participants' mouth. In addition, the use instrumental analysis (Praat 4.2.18) combined with auditory analysis

[6] See Appendix D for the chronology of the acquisition of BP stops as L1.

showed to be crucial in adding to the reliability of the judgments once the researcher could make use of visual and audio data.

3.3 Research questions and hypotheses of the study

The present study set three general goals. First, it aimed at investigating the types of mispronunciations, that is, the most recurrent simplification strategies applied by young Brazilian EFL learners when the target was an English word-final stop in CVC structures. Second, it aimed at investigating young Brazilian EFL learners' ability to discriminate CVC from CVC words, where the second consonant was a velar stop. Third, it attempted to establish the degree of relationship between their ability to produce and perceive the targets stops in CVC words.

In line with the literature in the field, the specific objectives of the study concerning production were to investigate the influence of markedness relations on the pronunciation of the word-final stop in the CVC syllabic pattern in terms of (1) voicing of the target consonant; and (2) place of articulation of the target consonant among the stops.

The research questions and hypotheses which guided the present investigation were based on the study questions of Koerich (2002) for Brazilian adults and adapted to the participants' age[7] . In addition, several other studies previously conducted in the field

[7] In comparison to Koerich's research, the present study limited the number of phonemes investigated and the environment, since only the final stops produced in isolated words were investigated here. In terms of speech perception, the present study aimed at observing the type of correlation between the two abilities in

of perception and production (e.g., Baptista & Silva Filho, 1997; Eckman, 1987; Flege, 1995; Weinberger, 1987; Yavas, 1994, 1997) also helped to establish the guidelines and framework within which the following questions were formulated:

Question 1: What simplification strategies do young Brazilian learners of EFL apply to word-final stops in English CVC words?

Hypothesis 1: Young learners of EFL apply simplification strategies such as devoicing, deletion, and epenthesis in the production of word-final stops in English CVC words.

Question 2: Does markedness in terms of voicing of the target consonant influence mispronunciations of word-final stops in CVC words?

Hypothesis 2: Voiced stops cause more mispronunciations than their voiceless counterparts.

Question 3: Does markedness in terms of place of articulation of the target consonant influence mispronunciations of word-final stops in CVC words?

Hypothesis 3: The velars cause more mispronunciations than the alveolars, which cause more mispronunciations than the bilabials.

Question 4: Is there a correlation between perception and production of the word-final stops in CVC words?

Hypothesis 4: Participants who produce more mispronunciations of the word-final

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general terms, whereas Koerich investigated the correlation in relation to voicing and consonantal strenght of the targets.

stops in CVC words fail more frequently to discriminate mispronunciations (CVCV) and correct pronunciations (CVC) of these sounds.

3.4 Participants

Twelve EFL young Brazilian students[8] (ages ranging from 4 to 6 years, M = 5 years and 2 months, SD = 0.57) participated in this study. At the time of the data collection they had been attending English classes for at least three semesters (M = 4.5 semesters, SD = 1.24). All the participants had started learning English when they were between two and four years old at the same school (ages ranging from 2 to 3 years and eleven months, M = 3.4 months). The participants were at a similar level of proficiency in English and were using the same textbook[9]. According to their teachers[10] as well as to what the researcher perceived in their speech, none of the participants in the study demonstrated lack of phonetic ability to produce the stops in their L1.

In terms of literacy, some of the participants had already been formally exposed to some written language in their L1, nevertheless they were only in the beginning stage of literacy instruction. In addition, neither of them had received explicit instruction on reading or writing in the L2. For instance, they had not been formally exposed to the written form of the vocabulary they were tested. Therefore, as the participants were naïve

[8] Data was collected with 16 participants; however 4 of them were not included in the study due to individual characteristics, which would set them as outliers or as part of a different linguistic population. For example, one student had strong difficulties in recalling the vocabulary and another student's L1 was Spanish.
[9] Buere, P. (2002). Parachutes 1: an integrated language course. McGraw-Hill / Companies, Inc.
[10] The two teachers working with the students involved in the research were young Brazilian females with very good English pronunciation.

regarding the rules of the English written form it was expected that their production would not be influenced by the fact that the words ended in consonants. Since this syllable pattern is not part of the participants' L1 phonotactic inventory, their production could suffer influence of the more marked English syllable pattern, the CVC. Having established the profile of the participants and obtained the permission from the school and parents for the data collection (Appendix E brings the letter of consent signed by the parents), the instruments were carefully prepared, based on the results of the pilot study.

3.5 Instruments

3.5.1 The software

A computer software was specially designed to collect the data for this study. The software comprised three different tasks – one for speech perception, one for speech production and one involving both abilities (the imitation task). The tasks were built in a computer-game format to promote the best interaction possible between the software and the participants, and in order to maintain their focus on the tests and their willingness to perform the tasks properly (Polka, Jusczyk & Rvachew, 1995). Particular attention was given to minimizing the aspects found to have interfered with the data in the pilot study, such as the interference of background noise in the quality of the recordings, and the emphasis given to the final consonants by the talker in the stimuli of the imitation task.

Besides that, the software was designed to be user-friendly and visually attractive so as to raise participants' curiosity and enthusiasm towards the tasks. The procedures and the technical tools (computer, mouse and headset) were prepared to offer a

comfortable setting for the participants and provide data reliability. Apart from verifying the technical aspects (i.e., the operation of the software and the data storage system), there was great concern with providing straightforward instructions and selecting unambiguous and attractive pictures and speech models. The instructions were planned to suffice to guide the participants along the three tasks (perception, imitation and picture-naming) and were recorded in BP by the researcher, since the goal was to have participants performing the best they could without much interference and distraction.

Two program designers from the Department of Systems Analysis at the Federal University of Santa Catarina (UFSC), Brazil, built the software especially designed by the researcher. A professional illustrator created the figures to serve as visual input in the program. The auditory input to test the participants' perception and production abilities was recorded by an adult American native speaker whose profile was chosen to follow the type of English input usually received by the participants, since the teachers of English for young children in Brazil are mainly young adult females with mainly American English accent. The talker was kept unaware of the focus of the study in order to have her uttering the words as naturally as possible. The recording of the stimuli was held in a quiet classroom at UFSC using an MD Sony walkman-recorder (NH700) and a Sony microphone (ECM-C10). Based on previous studies (Flege, MacKay & Meador, 1999), the talker was told to produce the target words in the following carrier sentence: "Now I say ..." five times, and afterwards the most representative tokens in terms of approximation to natural speech were edited out of the sentence using Sony Sound Forge 7.0 to be used in the experiment. The sound files were converted to WAV type and made available in the website (www.nupfale.ufsc.br) so that the computer programmers could access them.

The software was developed with special concern, having in mind the participants' age and L2 knowledge. Accounting for the possible interference of anxiety and distress in the participants' performance, the pictures included in the tests were similar to those used in the participants' English classes. Concerning the technological quality of the audio input used in the presentation of the words, it can be said that the talker's voice was clear and sounded natural. Since it was very important to guarantee the quality of the recordings of the participants' responses for posterior data analysis, the microphone and the classroom where the data was collected were chosen strategically to minimize background noise.

The responses of the perception test were stored in the interface of the software, which allowed for online storage of the data in the three tasks. In the perception task, the researcher also wrote down the responses during the data collection session, since the participants could fail to click on the intended answer. It was possible to detect a situation like that because the participants did not limit to clicking on the screen, but also provided their answers while doing that. The speech data (the recordings of the participants' imitation and picture-naming) and the response times in all tasks were stored in the laptop computer and then organized by participant. Besides that, the audio stimuli and the participants' responses in the imitation and production tests were recorded with a Sony MD walkman-recorder MZ-NH700 and a Sony ECM-C10 microphone as a backup data set. The imitation responses were analyzed in terms of production and perception.

3.5.2 The perception test: AX Discrimination task

The results of the pilot indicated that not only epenthesis but also devoicing were frequent strategies observed in the participants' productions. Therefore, it seemed quite important to devise a way to test both strategies and to investigate whether participants would show a lack of perception for these two speech variations. Due to aspects related to the participants' age, however, it was necessary to impose a limitation in terms of number of tokens (final-consonants to be tested) in order to avoid tiredness and maintain their interest. Bearing this in mind, two base words with the same vowel (/ ɪʊʊ̯ each with either the voiced or voiceless velar stop (i.e., "back" and "bag") were selected for the test. The choice of having the voiced and voiceless correspondents was motivated by the discussion about the effect of voicing on the perceptual ability.

The AX discrimination task used in this study was based on Polka, Jusczyk and Rvachew (1995). As stated in Chapter 2, the AX discrimination test was selected for the experiment because its level of complexity was considered adequate for young children. It aimed at verifying the participants' discriminatory perception of CVC segments (monosyllabic words) with stops in coda position from the same items with a final /i/. The test designed here consisted of 32 pairs of tokens (the words "back" vs. "backy" or "bag" vs. "baggy"). Sixteen pairs were formed of identical tokens (catch trials, see description below) and 16 of different tokens (different trials). For instance, the participant heard '*bag*' and '*baggy*' or '*bag*' and '*bag*' and had to indicate whether two identical words constituted the pair or two different words, by clicking on a happy – ☺ (identical) or sad face sad face – ☹ (different) on the computer screen.

The AX discrimination task was considered appropriate for the participants' age since it is used in activities children usually perform in school. In order to diminish the effect of guessing in the results, catch trials were included in the test. Catch trials are sequences of stimuli in which all the tokens are the same, that is, there is no odd item out (see Koerich, 2002 for a comprehensive description). The test had two parts – the training session and the test itself. The training session had eight pairs of CVC sequences – four catch trials and four different trials. The first two pairs of audio input were presented along with pictures to grasp the participants' attention with something more concrete than spoken words.

The relevance of the training session was twofold. Firstly, the participants were given the chance to go from visual and auditory stimuli to auditory only. The session started with a sequence of two pictures, each shown simultaneously with its correspondent speech token (i.e., "dog" and "dog"), for the participants to indicate whether they were the same or different. Following this presentation, only the auditory input was repeated, that is, the two names, guiding the participants towards the actual task they were supposed to perform. Secondly, the types of contrasts between the pairs of tokens were also presented gradually. At first, the pairs were composed of two totally different words (i.e., "cat" vs. "dog"), then they had different final consonants (i.e., "dot" vs. "dog"), then they had different vowels and different consonants (i.e., "dat" vs. "dog"), and finally, they were presented to the type of contrast they were expected to perceive in the test, the addition of the vowel /i/ to the CVC tokens (i.e., "bag" vs. "baggy"). Catch trials were also included in the training session. The test session had 32 pairs constituted of 16 catch trials – either CVC or CVC , and 16 different trials (Appendix B offers the

complete list of words). The response time for all participants was stored in order to provide data for a possible investigation between performance and response time.

3.5.3 Production test: the imitation and the picture-naming tasks

The selection of words for the imitation and picture-naming tasks took into consideration two main criteria – the feasibility of representing these words in pictures, and participants' familiarity with them. Since it was impossible to limit the words to those already familiar to the children, some new words had to be included, and the researcher used her common sense as a teacher of English for young learners, as well as the material and vocabulary found in the syllabus of the textbooks used in the language school the participants were attending EFL classes. The selected words were basically words naming animals, colors, body parts and school objects (Appendix B).

Whenever possible, since all words had to be represented in pictures, the priority was given to including words with non-high vowels as an effort to control for phonotactic probabilities of children produce different codas depending on the preceding vowel (Zamuner et al, 2004). Nevertheless, when the choice for a non-high vowel was not possible, the words were selected so that the target phonemes were the main difference. The objective of this selection was to minimize variation in the phonological environment preceding the final consonant, which could lead to different phonetic outputs.

Several researchers have used the imitation test to investigate speech perception (e.g., Beddor & Gottfried, 1995; Diehl, McCusker & Chapman, 1981; Flege & Hammond, 1982; Rochet, 1995). There are some advantages about the imitation task to

collect data on speech production as well. First, due to its nature, it is suitable for populations with restricted knowledge of the target language once the speaker receives the input right before having to produce it and s/he does not have to retrieve semantic information (Bates & Liu, 1996). Second, it guarantees the production of a predetermined set of words (Stoel-Gammon & Dunn, 1985). Nevertheless, since the imitation task involves both the perception and production skills, where perception is measured through production, mispronunciations may be caused by articulatory difficulties and not by poor perceptual ability (R. Denise Koerich, personal communication, April, 2004).

Thus, the analysis of perceptual data collected through imitation has to be very cautious and, ideally, be used in conjunction with other assessment instruments. In this study the imitation task was a "listen and repeat" activity using 24 different words, four for each target obstruent. The objective of the task was twofold: First it was used to promote familiarization with the vocabulary to be used in the subsequent free speech test (the picture-naming task), and second, to collect data (speech samples) from the participants to be compared with the data collected in the picture-naming task and to **assess perception as well.**

The free speech test was a picture-naming task largely used in EFL classes with youngsters and it is a good way to collect speech samples since there is no novelty in the task format that could bias the results. However, it does require from the speaker lexical knowledge of the items represented in the pictures. The test included 12 of the most familiar words represented in the pictures used in the imitation task; however, no auditory input was given. Each picture was presented twice.

The objective of this task was to collect output produced without the influence of an immediate preceding input, as it is the case of the imitation task. None of the tasks (the imitation and the picture-naming) included written input to prevent from orthographic interference. Since some of the participants were going through the process of learning to read and write in the L1, it was reasoned that there could be interference of the written form in their speech, as it was discussed in Koerich (2002). The imitation task, aimed at collecting data for the research questions investigating the production and perception of the CVC word-final stops (Research Questions 1 and 4), whereas the picture-naming task was specific for assessing production (Research Questions 1, 2 and 3).

3.6 Procedures

The data collection took place in the southern state of Santa Catarina, Brazil, in the second semester of 2005 at the language school where the participants had been attending English classes for about two years (MS = 4.5 semesters). The researcher had taught at that school some time before and was familiar with the method, the school premises and the staff. Apart from this fact, which facilitated the contact between the researcher and the school, the institution was selected for three main reasons: (1) the availability of English learners at very young age; (2) students' familiarity with the computer as a learning tool; and (3) the prevalence of instruction in oral over written language, which is not explicitly presented to the learners before they are eight years old.

Before starting the data collection, the researcher and the school administration

took a series of necessary precautions to formalize the event in the school. The researcher visited the school and explained to the school's principal how the data collection would take place. She also provided the school with forms for the parents and an explanatory letter with brief information about the data collection event (Appendix E). In addition, the researcher was aware that if the students did not show willingness to try the software she would have to respect it.

The students who accepted to participate in the experiment were tested individually during their class time by the researcher and a volunteer research assistant. The data was collected in three visits to the school, and each individual session took around 12 minutes. A preliminary meeting with the students was necessary to help creating a comfortable atmosphere and for the researcher to present the pictures, vocabulary and task types. This introductory meeting lasted about 15 minutes and it was very effective since the students participated enthusiastically of the activities, thus lowering the affective filter. In addition, it maximized the time and allowed the researcher to introduce the tasks as a regular school activity – a game, with all students participating together during circle time[11]. By doing so, it was expected that students would feel excited about taking the tests and confident on their ability to perform them well. This presentation session raised great curiosity and interest in the 'computer game', since almost all students volunteered to try the software after the group session.

After this first personal contact, the students who volunteered to participate were taken individually to a quiet classroom where there was a laptop computer (Toshiba model Satellite 1805) with the software ready to start and a headset connected to it. An

[11] Circle time is a moment when teacher and students sit on the floor in a circle aiming at developing the communicative skill. It is a good moment for the teacher to talk about important things because it is easy to gather students' attention in this situation.

audio recorder (Sony MD walkman model MZ-NH700) with a mini-microphone (Sony model ECM-C10) was also placed near the computer and used as a backup tool to record the participants' speech when interacting with the software, the researcher or the research assistant. As soon as the participant was sitting comfortably, the researcher briefly reminded him/her about the different tasks, and gave the instructions on how to give the commands, using the mouse, how to go on with the software and how to give responses. The responses had to be given either by clicking on the happy or sad face displayed on the computer screen, in the AX discrimination task, or by speaking on the microphone attached to the headset, in the imitation and in the picture-naming tasks.

When necessary, the assistant helped the participants using the mouse. As some children had difficulty moving the arrow on the screen with the mouse, they pointed to the screen or gave an oral answer; thus, the research assistant clicked the mouse according to the participants' response to move on with the test. The participation of the assistant in the data collection sessions was extremely important since it let the researcher free to observe and take notes about each individual session which demonstrated to be very useful in the analysis of the results. The participants had to use the headset all the time and they seemed to feel comfortable and to enjoy doing so. The headset was necessary to isolate external noise which could distract the participants, as well as to guarantee the quality of the recordings of the participants' productions.

3.6.1 The AX discrimination task

Prior to the test itself the participants went through a training session that gradually led them into the task they were about to engage in, promoting task familiarization and maximization of performance. This training session lasted about 30 seconds and it was carefully designed and applied. The words were presented randomly and the speech model and the pictures showed to be highly adequate in terms of audio quality and picture recognition.

As mentioned before, in the AX discrimination test, if the participants considered the two words presented to be identical they had to click on the happy face, and if they considered the words to be different, they had to click on the sad face. Yet, some of the participants interacted spontaneously with the software saying the words “igual” (same) or “diferente” (different) and preferred to have the assistant clicking for them. The perception test lasted about seven minutes (M = 7; SD = 1.43), and it could be observed that some of the participants showed signs of boredom and tiredness towards the end.

3.6.2 The imitation and the picture-naming tasks

After concluding the perception test, the participants were guided to the imitation task. This task was more dynamic and visually more attractive than the perception test, since the participants’ enthusiasm increased considerably. It seemed that the participants found this task easier to perform. Before starting it, participants were told that the words would be repeated throughout the game and that they should try to remember them. This

was done to try to keep the children concentrated during the data collection. They were instructed to speak naturally and loud enough to record and, as soon as they repeated a word they should click on the arrow that appeared at the bottom of the computer screen to move on. This part of the data collection procedures lasted about two minutes (MS = 1.40 minutes; SD = 0.63), and most of the children wanted to handle the computer mouse, and did not need help from the assistant.

Right after the imitation task participants were led to the picture-naming task. They were asked to name 12 of the pictures previously presented in the imitation task. The set of pictures was presented, one picture at a time to be named by the participants. This procedure was repeated in a randomized order so that a total of 24 words were collected from each participant. The repetition aimed at increasing the number of speech samples collected, at the same time maintaining a small number of different words to avoid memory load or lack of vocabulary interference. This part of the production data collection procedure took longer than the imitation test. It lasted about three minutes (MS = 2.40 minutes; SD = 0.59).

None of the participants was able to complete the task successfully. Many times a child would ask for the researcher's help because s/he could not remember the English word to name the picture shown. In this case, the researcher said the word[12] for the child to repeat, and since these productions were, in fact imitations, they were not computed in the picture-naming dataset, but in the imitation dataset.

[12] As the input for the imitation task had been recorded (see comments about the reason for that in section 3.5), in these situations the researcher was very careful to say the words as similar to the talker in the recordings as possible, and when analyzing the files she verified her production, excluding all responses that had traces of her production. In fact, no such file was found, so the data were not compromised.

3.7 Data Analysis

This research was carried out within a quantitative framework, and it looked into the data on the L2 perception and production to observe tendencies in the participants' responses. Nevertheless, when pertinent, individual differences were taken into account and discussed under a qualitative view. Three different sets of data were analyzed: (a) the data on speech perception collected through the AX discrimination task and the imitation task, and (b) the data on speech production collected through the imitation task and the picture-naming task. Due to the different number of instances produced by each participant in both the imitation and the picture-naming tasks, the scores were analyzed in percentage values calculated from the maximum number of outputs possible and the outputs of each participant.

The results gathered in the imitation and picture-naming tasks were stored in the software interface and in HI-MD files. The data of the AX discrimination task were stored in the software and also noted down by the researcher as a second data resource in case there were problems with the software. In addition, notes were taken throughout the test sessions in order to register relevant information for the discussion of the results, such as the occurrence of emotional distress or any disabilities, and particularities about the participants' oral productions. The data was analyzed investigating the extent to which the perception and production of the group supported or refuted the hypotheses formulated in this study.

3.7.1 Speech perception data

The variable directly investigated in the perception test was the A-prime (A') scores for the discrimination of the CVC and CVCV words where the final vowel was /i/. The A' scores were calculated by computing the percentage of correct answers in the different trials (hits – H) and the percentage of errors obtained in the catch trials (false alarms – FA). According to Koerich (2002), Flege (unpublished paper) considers that the A-prime allows for the "calculation of an unbiased measure of perceptual sensitivity to the phonetic contrast under investigation, since to obtain a high score participants have to respond to relevant phonetic differences, ignoring irrelevant auditory accessible differences between the stimuli, such as voice quality (p. 140)."

Once every participant had H values higher than the FA values, only one formula was applied in the calculation of the A', which was the following:

$$\text{If } H > FA,\ A' = 0.5 + \frac{(H - FA) * (1 + H - FA)}{4H * (1 - FA)}$$

An A' score of 1.0 indicates perfect sensibility to the phonetic contrast addressed. It occurs when all trials are responded correctly. An A' score of 0.5 indicates a lack of sensitivity and occurs when H and FA rates are equal (Flege et al., 1999). In order to answer Research Question 4, investigating the type of correlation between perception and production, the A' score calculated for each participant was tabulated and compared in two different ways. Two comparisons were made, first the A' scores and the target-like scores obtained in the production test were compared. Second, the imitation scores were

used as representatives of perceptual sensitivity being compared to the production target-like scores gathered in the picture-naming test. This second comparison was carried out aiming to verify whether the imitation task was appropriate to measure perceptual ability as well and if so to have parallel results of the participants' perceptual ability for the confirmation of the results obtained in the AX test.

3.7.2 Speech production data

Concerning the object of investigation, the production of final stops in CVC structures, the speech stretches were transcribed, classified and arranged by the researcher as follows. The researcher using the International Phonetic Alphabet (IPA) made three independent transcriptions of each utterance. The first transcription was elaborated from listening to the MD recordings, and the second and third transcriptions were done in different moments (a few days apart) using instrumental analysis for acoustic phonetics (Praat 4.2.18). The instrumental analysis was important increasing the reliability of the judgment, and it excluded the necessity of a second judge. In addition, the notes taken by the researcher during the meetings with the participants were also compared to the data. The tokens for which there was agreement in the three transcriptions (570 of 576 tokens) were selected and included in the datasets.

The interpretation of the spectrograms created from the speech strings by Praat was based on Ladefoged (2001). Concerning the stops, the author states that "whichever stop is formed or released, there will be a particular shape of the vocal tract that will be characterized by particular formant frequencies" (p. 179). Thus, it is expected that the

visual form of the speech sound offered by the software analysis shows features that enable researchers to identify the characteristics of the speech string under analysis. In addition, a comparison to the model provided in the imitation test with the participants' outputs was also made whenever necessary.

In the present study the analysis aimed at distinguishing the characteristics of the final stop followed by silence from that followed by a vowel. When followed by silence, final stops are usually released. Variations in terms of voicing and place of articulation were also investigated, aiming to find patterns in the participants' speech. According to Ladefoged (2001), voiced stops have "evidence of voicing near the baseline during a consonant closure [which] is called a voice bar" and there is "the apparent point of origin of the formant for each place of articulation called the **locus** of that place of articulation" (p. 179). For the voiceless stops, concerning their frequencies, the author points out that /t/ has the highest frequency followed by /k/, and then by /p/. The degree of frequency is given through the expected degree of aspiration produced after the release of the voiceless stop.Moreover, in the present study the tokens were classified and organized in tables using the Excell for Windows 2000. After that, the regularities and variations in the results were investigated and the percentage values were calculated. Statistical analysis, using the SPSS 11.0, was used whenever possible, aiming to investigate the occurrence of significant differences in the confrontation of variables. However, since the dataset was non-parametric, statistical significance was not always reached, and the percentages were analyzed together with the interpretation of the test values. The tests used in the present study were Paired t-tests and Wilcoxon and Pearson correlation as well as Friedman tests. In addition, individual differences also showed possible patterns in the participants' interlanguage.

In Macken and Barton (1980) English-speaking adults judging English children voicing contrast reported that they heard voiced stops when with the spectrographic analysis the authors found out the children where actually producing voiceless unaspirated stops instead. Early acquisition of the voicing contrast in the child's L1 suggests an early acquisition of the same contrast in a FL if both languages share the contrast. It is true that the differences in voice quality[13] of different languages also interfere with how sounds are produced; thus when analyzing a certain phonetic feature, considerations about features of voice quality should be drawn once they can explain at least part of the findings.

[13] According to Pennington and Richards (1986), voice-setting features are related to general articulatory postures of the vocal apparatus, resulting in a characteristic voice-quality of a certain language or individual. Laver (1980, p. 2) exemplifies these phonetic settings or voice-quality settings with the "whispery" mode of phonation. Therefore, any quasi-permanent tendency throughout the speech contributes to creating the voice-quality (e.g. loud, slow, nasalized, harsh, whispery, creaky).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter reports the results of the present study and discusses them based on theoretical and experimental studies reviewed in Chapter 2. The analysis focuses on the four hypotheses posted for the research questions investigated: Hypothesis 1 predicted that BP young learners of English apply simplification strategies such as devoicing, deletion, and epenthesis in the production of English word-final stops. Hypotheses 2 and 3 dealt with the effect of markedness relations in terms of voicing and place of articulation on the production of English word-final stops. Finally, Hypothesis 4 investigated the correlation between perception and production of these stops.

It is important to notice that the results of the imitation task were analyzed as production data in the discussion of H1, when they were reported together with the results of the picture-naming task. Except for the analysis of H1, the results obtained in the imitation task were analyzed as perception data (H4). As commented in Chapter 3 (sections 3.2.2 and 3.5.3), imitation tasks have been used in the literature to assess the perceptual performance; however, in this study, accounting for Beddor and Gottfried (1995), and to Koerich's comments (personal communication, April, 2004) the task was used to assess production as well as perception adding to the data collected through the picture-naming task and the AX task, respectively.

The maximum number of tokens gathered in the imitation and picture-naming tasks

varied considerably by participant, mainly due to difficulty in retrieving words naming some pictures. As reported in Chapter 3 (section 3.6.2), none of the participants was able to complete the picture-naming task successfully. Whenever a child could not recall the word to name a picture s/he asked for the researcher to say the word, and so she did using spontaneous speech. This procedure was chosen for three reasons: (1) the need to gather a reasonable number of outputs of the six target phonemes; (2) the fact that the participants were not familiar with the words ending in the voiced bilabial stop (/b/)[14]; and (3) to maintain participants' motivation encouraging them to go on with the test, avoiding drop offs in face of difficulty to recall a word. The samples produced in this situation (after the researcher's modeling) were computed within the results of the imitation task. Because some outputs presented dual mispronunciation (e.g., devoicing and aspiration, or epenthesis and aspiration) the number of mispronunciation computed is greater than the number of outputs produced by the participants.

Due to the great difference in the number of tokens gathered from each participant, the scores were treated in terms of percentage values (Appendix C). The tables in this chapter bring the Percentage Scores, the Medians (M) and the Standard Deviation (SD) values. In addition, statistical analysis was applied to the data aiming to support the interpretation and discussion of the results of this study. Since the dataset was non-parametric and the study had a within group design, paired sample t-tests and the Wilcoxon Signed Rank Tests were ran between pairs of variables. When more than 2 variables were compared, the Friedman Test for Several Related Samples was used as the starting procedure, and if significance was reached, the Wilcoxon test was applied to the pairs of variables. These tests yielded results to substantiate the direction of the analyses

[14] The words tested were: lab, web, tub and bib.

and discussions. Although some results did not show statistical significance, tendencies in the speech perception and production could be observed, and the results allow for relevant insights and hypotheses for further research.

4.2 Simplification strategies applied by BP young learners– HYPOTHESIS 1

Hypothesis 1 predicted that young BP speakers tend to apply simplification strategies such as devoicing, deletion and epenthesis to produce English word-final stops in CVC words.

As predicted in this hypothesis, two types of simplification strategies were observed in the participants' productions of final consonants in CVC words: (i) syllable simplification strategies (vowel epenthesis and deletion); and (ii) target sound substitution – phoneme simplification strategies (aspiration, devoicing and fronting). Vowel epenthesis is the process of inserting a vowel, which in the case of BP speakers, is in general / / (see Koerich, 2002), resulting in pronunciations of CVC words as CVC/ / (e.g., cat pronounced as [k]). Deletion is the loss of a segment such as in 'cat' pronounced as [k]. Aspiration, as a mispronunciation of a word-final consonant, happens when this consonant is followed by a 'puff of air'. Devoicing happens when a voiced consonant loses its voicing and it is pronounced as a voiceless one as in the word bag pronounced as [ ]. Finally, fronting happens when the articulation moves closer to the front, such as in the case of the word 'leg' pronounced as [ ]. In this process velars may move to alveolars, and then to bilabials.

Table 1 shows the rates of simplification strategies applied by the participants when producing the CVC words in the experiment (the individual scores are available in Appendix C, Tables 1.1 and 1.2). As it was mentioned in Chapter 3, the number of production outputs varied considerably by participant, therefore, the mean scores are presented in percentage values.

Table 1
Rates of simplification strategies applied to the CVC structure

Simplification Strategy	Epenthesis	Deletion	Aspiration	Devoicing	Fronting
Nº Productions	186	186	186	83	158
Nº of occurrence	25	1	102	8	1
% of occurrence	13.44	0.53	54.84	9.64	0.63
Median	9.19	.00	57.19	6.25	.00
SD	18.51	1.69	24.21	12.42	2.06

Corroborating previous studies (e.g., Eckman, 1981; Heyer, 1986; Weinberger, 1987) the rate of deletion was extremely low. The fact that deletion did not occur so frequently might be related to the principle of recoverability proposed by Weinberger (1994). As it was explained in Chapter 2, the recoverability principle becomes available to speakers when they gain language experience and lexicon knowledge and it constrains certain processes to happen to avoid ambiguity in the output. For instance, when learners know that there are two complex words that distinguish only by the final stop (‘cat’ and ‘cap’), the simplification strategy usually chosen, due to the recoverability principle, is the epenthesis rather than the deletion of the final stop, because by adding the final vowel the pattern of the word is maintained and so is the meaning. In other words, when epenthesis suppresses deletion it indicates that the learner is trying to maintain the

original structure of the word, whereas the choice for deletion would increase the level of ambiguity. It seemed that the recoverability principle was already accessible to the speakers, influencing the low occurrence of deletion.

As it was the case of deletion, fronting occurred only once. Fronting and devoicing are considered universal tendencies in the early stages of L1 acquisition during the development of the necessary articulators (the vocal apparatus), and of the cognitive processes involved in the production of speech sounds (Katamba, 1989). In L2 research fronting and devoicing are not expected to appear in the interlanguage phonology of the learner if they are not part of the L1 phonotactic rules. In fact, the occurrence of both strategies was low – 0.63% for fronting and 9.64% for devoicing.

The spectrograms showed evidence of aspiration on final-stops. The degree of intensity expected to occur in natural speech was measured based on Ladefoged (2001) and by comparing the participants' outputs with the model produced by native-speakers. When classifying the outputs as target-like or not, it seemed reasonable to look into the intensity of the puff of air released after the final stop which should not be as strong as the peak of the syllable. In case of a strong puff of air the instance was classified as strongly aspirated, since aspiration interfered with the sonority balance of the syllable. Tokens which had only a strong release or a small aspiration after the release were considered target-like, since this type of realization can occur in native speech when the final-stop is followed by silence.

Aspiration was the most frequent strategy applied by young learners of English (54.84%). It was possible to observe in the spectrograms that there were various degrees of aspiration, and there was also palatalization of the alveolar consonants. According to

Monaretto, Quednau, and Hora (1999) palatalization is the commonest allophonic variation involving the alveolar stops in BP, and it is a process spreading quickly in the country (see discussions and descriptions of palatalization in BP in Albano, 1999, 2001; Bettoni-Techio, 2005; Bettoni-Techio & Koerich, 2006; Cristófaro Silva, 2002). In English the affricates are phonemes and not allophonic variations of / / and / / and they should not be used interchangeably. A reasonable explanation for the occurrence of palatalization with alveolar consonants is that it signals that there was transfer of the tendency to palatalize these consonants in BP to the English productions. It seems that because the final stops were followed by pause, aspiration was quite strong that it resulted in palatalization in the case of final alveolars.

Concerning the epenthetic vowel, previous studies with Brazilian adults have indicated that English CVC words tend to be produced as CVCV, where the final vowel is an / / or /e/, following the syllabic pattern of BP (Baptista & Silva Filho, 1997; Koerich, 2002; Silveira, 2004). The rates of epenthesis in these studies vary, probably owing to participants' different L2 proficiency levels, as Koerich argues. In the present study, participants produced 13.44% of the CVC words as CVCV.

Statistical tests comparing the simplification strategies in terms of syllable simplification strategies and target sound modification strategies – phoneme simplification – showed that the difference between the two syllable simplification strategies applied by the participants, epenthesis and deletion, as the numbers indicated, was significant, as revealed by the Wilcoxon Signed Ranks Test ($z = -.207$, $p = .027$). Concerning the three phoneme simplification strategies – aspiration, devoicing and fronting – pair wise Friedman tests for Related Samples were run to verify whether the

difference was significant. The results confirmed what was observed from the percentage values. The test indicated that the difference among the three strategies was highly significant ($p = .000$). Nevertheless, it was necessary to investigate where exactly this significance was marked, that is, between which pairs of strategies. Hence, post-hoc Wilcoxon paired tests were applied. The comparison between aspiration and devoicing reached statistical significance ($p = .004$), as well as the contrast between aspiration and fronting ($p = .002$); however, the difference between devoicing and fronting showed be significant ($p = .027$).

The comparison between the two most frequent strategies applied by the participants – aspiration and epenthesis – yielded significant results ($p = .006$). This significant difference between the occurrence of aspiration (54.84%) and epenthesis (13.44%) indicates that over-aspiration of the final stop after its release is significantly more common than the use of the epenthetic vowel, reinforcing the speculation that L1 transfer strongly influenced the production of alveolar consonants, since the alveolars are often palatalized (over aspirated) in some BP dialects.

As a possible source of arguments for discussion the results were further analyzed by task – the production data gathered through the imitation task vs. the data from the picture-naming task. It was speculated that there could be differences related to the fact that in the imitation task, once the speech model is provided right before the speaker's production, there is a greater tendency for speakers to reproduce it more accurately than in the picture-naming task, where no model is provided and the speaker has to retrieve the speech sample from memory.

However, since it is not the objective of this study to investigate the effect of

different tasks in the production (and perception) of speech, a discussion about aspects inherent to each task is not deeply developed here. For example, such a discussion would have to explore carefully the matters of attention to speech (form vs. content), and degree of control in each task; however, the literature on these matters is not only vast, but also complex and controversial. Thus, as mentioned above, the results provided by different data gathering instruments in this study are reported separately only for raising comments and speculate on any aspect considered interesting to be brought to light. Tables 2a and 2b present the rates of CVC target-like production by task and by each participant, ranking from the most to the least accurate performance.

Table 2a

Rates of CVC target-like outputs in the imitation task

Participants	CVC tokens	CVC %
S11	27/29	93.10
S9	25/29	86.21
S2	29/34	85.29
S7	23/30	76.67
S10	20/29	68.97
S4	22/36	61.11
S5	18/32	56.25
S8	16/29	55.17
S12	15/35	42.86
S6	13/31	41.94
S1	8/38	21.05
S3	5/32	15.63
% CVC	221/384	57.55
Median		58.68
SD		25.05

Table 2b

Rates of CVC target-like outputs in the picture-naming task

Participants	CVC tokens	CVC %
S11	16/18	88.89
S2	11/14	78.57
S9	8/18	44.45
S7	6/17	35.29
S5	4/15	26.67
S6	4/17	23.53
S3	3/16	18.75
S8	3/17	17.65
S10	3/19	15.79
S4	1/12	8.33
S1	0/10	0
S12	0/13	0
% CVC	59/186	31.72
Median		21.14
SD		28.39

In order to have statistical support about the significance of the difference in the participants' performance depending on task type, paired T-tests were run with the rates obtained in the two tasks. According to the 2-tailed Paired T-test the difference between the rates of CVC target-like production in the two tasks was highly significant ($t(11) = 5.211$, $p = .000$), meaning that the results were strongly affected by task type.

According to Major's Ontogeny Model of phonology development (1987) imitation triggers developmental processes (e.g., devoicing) to occur in a greater quantity, whereas picture-naming triggers more transfer strategies (e.g., epenthesis and palatalization). Wilcoxon tests run on the results of occurrences of epenthesis and devoicing obtained in

the two tasks (imitation and picture-naming), show that, even though the rate of devoicing was higher in the imitation task than in the picture-naming task, and the rate of epenthesis was higher in the picture-naming test, following the tendency stated by Major, none of the differences were statistically significant.

Table 3
Rates of devoicing and epenthesis in both tasks

	Epenthesis Imitation	Epenthesis Picture-naming	Devoicing Imitation	Devoicing Picture-naming
Mean Score%	14.85	13.44	19.79	9.64
Median	6.56	9.19	11.51	6.25
SD	15.50	18.51	19.43	12.42

Independently of task type, the rates show that there was considerable individual variation in the results obtained for CVC target-like outputs in both tasks. Nevertheless, comparing the individual rates, as well as the percentage scores and the Medians obtained for the imitation and the picture-naming tasks, it can be seen that participants' performance in the former was considerably better than in the latter (See table 2a).

Interestingly, analyzing the individual variation by task, it was observed that the same participant who reached the highest rate of CVC target-like in the imitation test was the one with the best performance in the picture-naming task (S11). In fact, participants S2, S7, S9 and S11 appear in the first four positions for accurate pronunciation in both tasks, whereas S1 showed one of the poorest productions independently of task type. Except for S3, all the other participants followed the expected tendency of better performance in the imitation task than in the picture-naming task.

In sum, by analyzing the results regarding Hypothesis 1, it was observed that this group of participants resorted to simplification strategies quite often supporting the

prediction posted here. In fact, among these strategies there were two main types (1) those that simplify the marked unit (CVC) either by deletion or epenthesis and (2) those that modify the target phonemes (final stops) either by aspiration, devoicing or fronting. In relation to syllable simplification strategies statistical significance was reached favoring the use of epenthesis over deletion (z = -.207, p = .027). This preference was explained in terms of the recoverability principle, since it prevents strategies that lead to ambiguity of word meaning. Regarding the strategies that modify the target phonemes, high statistical significance was found among the three strategies (p = .000). In addition, since aspiration was the most frequent variation (54.84%), post-hoc Wilcoxon paired tests were applied and they showed that statistical significance was reached between aspiration and devoicing (p = .004), as well as between aspiration and fronting (p = .002). However, no significance was found between fronting and devoicing. Furthermore, statistical significance was also reached between the two most recurrent strategies, aspiration and epenthesis, (p = .0067), supporting the idea about L1 transfer influencing L2 production of the alveolars / / and / /.

Another fact found to interfere in the output productions among this group of participants was the task type. In order to find statistical significance 2-tailed Paired T-test was used and it showed high significance of target-like productions in the imitation task (t(11) = 5.211, p = .000), corroborating previous studies on the effect of task on production. Nevertheless, even though the individual comparison of CVC target-like productions showed individual variation seemed to have a strong effect, the great majority (except for S3) had higher scores in the imitation task.

4.3 Markedness by voicing – HYPOTHESIS 2

Hypothesis 2 was formulated based on Eckman's (1977/1987) MDH. It predicted that word-final voiced stops in CVC words would cause more mispronunciations than their voiceless counterparts. As it can be seen in Table 4, the results of this study did not provide support for the hypothesis. Regardless of task type[15], the results showed that the participants produced more target-like CVC words when the final consonant was a voiced stop. The Wilcoxon test for statistical significance indicated that the difference in the rates (MS = 33.73%, for voiced stops vs. MS = 30.10% for voiceless stops) was not significant (z = -1.48, and p = .139), though.

Table 4
Rates of CVC target-like outputs by voicing

	Voiced				Voiceless			
	/b/	/d/	/g/	Total	/p/	/t/	/k/	Total
Nº Productions	7	30	46	83	19	42	42	103
Nº of correct CVC	5	7	16	28	13	6	12	31
% correct CVC	71.43	23.35	34.78	33.73	68.42	14.28	28.57	30.10
Median				31.25				19.09
SD				30.56				28.95

Table 5 presents the rates of epenthesis by phoneme and the mean scores for the groups of voiceless and voiced phonemes. The results in this study show that markedness in terms of voicing influence epenthesis production, corroborating previous studies (Baptista and Silva Filho, 1997; Koerich, 2002; and Silveira, 2004). This fact shows a

[15] The analysis was carried out with the dataset collected through the imitation task as well.

tendency to support Hypothesis 2, since it predicted more mispronunciation for the voiced targets. However, the Wilcoxon test did not yield statistical significance (z = -1.183, and p = .237).

Table 5

Rates of epenthesis by voicing

	Voiced				Voiceless			
	/b/	/d/	/g/	Total	/p/	/t/	/k/	Total
Nº Productions	7	30	46	83	19	42	42	103
Nº Epenthesis	2	5	14	21	4	7	3	14
% Epenthesis	28.57	16.65	30.43	24.09	21.05	16.65	7.14	13.59
Median	.00	.00	25	18.75	.00	.00	.00	.00
SD	31.79	44.54	34.69	31.76	31	31.07	31.08	28.35

The analysis of individual differences (Appendix C, Table 5.1) showed that 6 participants produced more accurate voiced final consonants in CVC words than voiceless consonants, whereas 3 participants followed the tendency in the hypotheses. Interestingly, it was observed that four participants (S1, S3, S4 and S12) had no CVC target-like production for all tokens of voiceless stops (/ /, / / and / /), which could have interfered with the overall results.

4.4 Markedness and place of articulation – HYPOTHESIS 3

Hypothesis 3 was formulated based on Yavas (1994/1997) and Freitas (2004) studies which showed evidence of markedness effects on the order of acquisition of stops in relation to their place of articulation (bilabials, alveolars and velars). The starting point was the idea that the voiced stops would cause more difficulty than the voiceless ones

(H2). Hence, the prediction posted here is that the voiced velar stop would cause more mispronunciations of the final consonant in CVC words than the voiced alveolar, which would cause more mispronunciations than the voiced bilabial stop.

The analysis of the productions showed that, in fact, contrary to the hypothesis, the alveolar voiced stop presented more mispronunciations, then the velar, and then the bilabial. An additional analysis of the productions, including the voiceless stops was, then, carried out in order to check for the effect of markedness relations by place of articulation regardless of voicing. Table 6 presents these data.

Table 6
Rates of CVC target-like productions by place of articulation

P. Articulation	% Bilabials		Total	% Alveolars		Total	% Velars		Total
Phoneme	/p/	/b/		/t/	/d/		/k/	/g/	
Nº Productions	21	7	28	42	30	72	40	46	86
Nº of correct CVC	13	5	18	6	7	13	12	16	28
% Correct CVC	61.90	71.42	64.28	14.28	23.34	18.05	30	34.78	2.56
Median	50	.00	58.35	.00	.00	.00	2.50	25	1.25
SD	43.30	45.02	41.20	25	37.85	28.78	34.88	34.47	30.58

Table 6 shows that, although concerning voiced stops, the results of the present study totally contradicted the hypothesis, the results for voiceless stops and for stops overall followed the hypothesis with respect to the lowest rate of mispronunciations for bilabials. It seems reasonable to speculate that the highest rates of mispronunciations for alveolars rather than for velars shown, both in the case of voiceless and of overall stops, result from the tendency for aspiration and palatalization of the alveolars.

The Friedman test for Related Samples was used to investigate the statistics of the results concerning the three groups of consonants, and the differences revealed to be significant (p = .01). Nevertheless, it seemed necessary to investigate which differences

by pairs were actually significant, and post-hoc Wilcoxon Signed Ranks tests were applied by place of articulation. According to the test, the differences between the alveolar and bilabial stops were significant (z = -2.492, p = .013) and between the alveolar and the velar stops were not significant (z = -2.091, p = .037). However, the difference between the bilabials and the velars was not statistically significant (z = 1.680, p = .093). In addition, the individual analysis of the participants' scores did not indicate much consistency between target-like productions and place of articulation (see Appendix C, Table 6.1 and 6.2 reporting individual scores).

In order to compare the results found here to results of previous studies investigating the effect of markedness by place of articulation, the data about epenthesis production is shown in Table 7. As shown, in the present study, the rates of epenthesis were higher for the bilabial stops, followed by the velars, and then the alveolars; however the differences were not statistically significant.

Table 7
Rates of epenthesis by place of articulation

P. Articulation	% Bilabials		Total	% Alveolars		Total	% Velars		Total
Phoneme	/p/	/b/		/t/	/d/		/k/	/g/	
Nº Productions	21	7	28	42	30	72	40	46	86
Nº of Epenthesis	4	2	6	7	5	12	3	14	17
% Epenthesis	21.05	28.57	21.43	16.65	16.65	16.65	7,50	30.43	19.76
Mean	14.58	12.50	20.14	17.36	27.08	18.68	12.50	30.55	21.72
Median	.00	.00	.00	.00	.00	.00	.00	25	15.46
SD	31	31.79	30.86	31.07	44.54	30.74	31.08	34.69	28.93

The tendency of occurrence of epenthesis regarding place of articulation in this study is distinct to that in previous studies. Baptista and Silva Filho (1997), Yavas (1994,

1997), Koerich (2002) and Silveira (2004) found the tendency predicted according to markedness relations, that is, epenthesis was more frequent following velars, then alveolars, and then bilabials. The first two studies do not provide statistical data and in Koerich (2002) and Silveira (2004) the results did not reach statistical significance to support the hypothesis entirely.

As an attempt to investigate the reason for the tendency of the results found here, Table 8 presents the occurrence of aspiration by place of articulation. As the table shows, the alveolars were the most frequently aspirated stops, as expected taking into consideration the tendency for palatalization of alveolars in the L1.

Table 8

Rates of aspiration by place of articulation

	Bilabials	Alveolars	Velars
Nº Productions	28	72	86
Nº of Aspiration	3	57	42
% of Aspiration	10.71	79.16	48.83
Mean	8.33	79.58	47.81
Median	.00	90	57.14
SD	20.71	28.19	32.23

Pair-wise Friedman tests for Related Samples indicated that the differences were highly significant ($p = .000$), and post-hoc Wilcoxon paired tests yielded significant results as well. The comparison between bilabials vs. alveolars, and bilabials vs. velars showed to be highly statistically significant ($z = -3.072$, $p = .002$, and $z = -2.703$, $p = .007$, respectively), and the pair alveolars vs. velars also reached statistical significance ($z = -2.589$, $p = .010$).

The results for aspiration partially support Hypothesis 3, corroborating previous studies in two ways. Firstly, because they provide evidence that transfer strategies interfere in L2 production, operating in consonance, but mostly overruling the influence of universal markedness relations. Secondly, because the bilabials were the least aspirated stops. However, the alveolars, due to L1 transfer were the ones with fewer target-like productions.

It can be said that the present study does not corroborate the prediction that markedness by place of articulation has a decisive influence on the production of CVC word-final stops, where there is a tendency for velars to cause more mispronunciations than alvelars, and than bilabials. On the contrary, in this study the alveolars were the final-stops presenting mispronunciations more frequently, followed by the velars and then, the bilabials.

The investigation about the possible reasons for the strong preference for aspiration of alveolar stops in the present study in contrast with the results of previous studies, has to take into consideration that (i) the previous studies mentioned above investigate only epenthesis production, whereas this study investigates mispronunciations of the final stop as a whole; and (ii) the previous studies collected data on final stops in different phonological environments, that is, final stops were followed by other consonants, by vowels and by pause, whereas in this study all the productions were in the phonological environment of a pause (isolated words).

4.5 Relationship between perception and production – HYPOTHESIS 4

Hypothesis 4 predicted that participants who produce more mispronunciations of the word-final stops in CVC words fail more frequently to discriminate mispronunciations (CVCV) and correct pronunciations (CVC) of that sound.

Flege's (1995) study on the relationship between perception and production using an ABX (X being either A or B) discrimination test found a positive correlation between these two abilities. Koerich's (2002) results of the investigation about BP speakers' production and perception of epenthesis corroborated Flege's.

The discussion about the level of correlation between EFL perception and production abilities in this study was provided by data from the calculation of the A' scores in the AX discrimination task and the scores in the imitation task for L2 perception, and by the scores in the picture-naming task as indicators of production ability. It is important to mention that the A' scores obtained in the AX task through the application of the formula (see Chapter 3) to the percentages of hits (H) and false alarms (FA) were calculated in decimals, whereas the rates in the imitation and picture-naming tasks were calculated in percentages; thus the A' scores were transformed into percentages in order to cross the values.

Table 9 shows the individual percentages for the A' and the percentages of CVC target-like productions in the picture-naming task. As can be seen, perception outperforms production in almost all cases, except for S11. In addition, the analysis of the individual percentages in the perception test (AX discrimination task) showed that they

ranged from 50% to 65.80% among the 12 participants, whereas the production rates varied from 0% to 88.89% and no tendency was detected.

Table 9
Rates of correct discrimination in the AX task and of CVC target-like productions in the picture-naming task

	Perception A’	CVC through picture-naming
S1	50.1	0
S2	50	78.57
S3	50.1	18.75
S4	50.1	8.33
S5	50.4	26.67
S6	65.8	23.53
S7	60.4	35.29
S8	50	17.65
S9	51.9	44.44
S10	50.1	15.79
S11	53.2	88.89
S12	50.1	0
Mean	52.68	31.72
Median	50.10	21.14
SD	5.09	28.39

A two-tailed Spearman Correlation test was used to correlate the values obtained in the AX task and in the picture-naming task, aiming to investigate whether there was correlation between perception and production as measured by these two tasks; however, the test showed a weak correlation and did not yield statistical significance, *rho* (12) = .39, p = .206.

The results of the data gathered through the imitation task as perception are shown in Table 10, together with the percentages of CVC target-like productions in the picture-naming task.

Table 10

Rates of correct imitation and of CVC target-like productions in the picture-naming task

	CVC through Imitation	CVC through picture-naming
S1	21.05	0
S2	85.29	78.57
S3	15.63	18.75
S4	61.11	8.33
S5	56.25	26.67
S6	41.94	23.53
S7	76.67	35.29
S8	55.17	17.65
S9	86.21	44.44
S10	68.97	15.79
S11	93.10	88.89
S12	42.86	0
Mean	57.55	31.72
Median	58.68	21.14
SD	25.05	28.39

A 2-tailed Spearman's Correlation test was run and this time statistical significance was reached at .05 level (*rho* (12) = .70, p = .011) indicating a moderate correlation between perception (measured through imitation) and production. The graph bellow illustrates the correlation found between these two abilities.

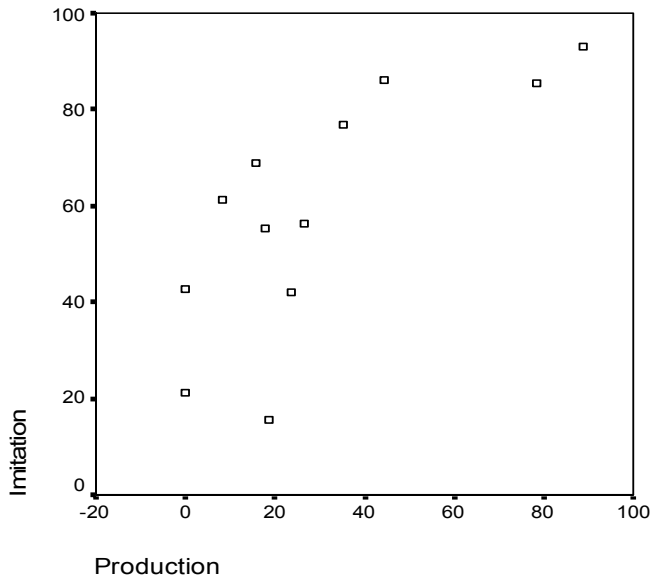

Figure A. Correlation between imitation (perception) and production rates

The analysis of the individual scores shows that almost all rates of perception are higher than the rates of production, indicating that perception tends to be developed before production. The individual analysis shows that all participants, except for S3, corroborated Koerich's (2002) results, regarding the order of development of perception and production abilities, which indicated that perception developed before production. It must be noted that participant S3 showed an interesting pronunciation of the target stops. He was very comfortable during the imitation task and 'played' with the final stop, emphasizing the release and producing a strong puff of air after the stops, just like some native children do. As a result, his CVC target-like mean score in the imitation task was lower than his production in the picture-naming task(imitation MS = 15.63% and production MS = 18.75%). This difference for target-like production in the picture-naming task may be due to the fact that he uttered the words more naturally in this task, reflecting better his ability to produce the target forms.

In sum, the data regarding the correlation between perception and production were analyzed in two ways and they yielded different results. First the A Prime scores (AX discrimination test) were correlated with the CVC target-like productions in the picture-naming task and no statistical significance was found. Second, the imitation data (seen as a measure of perception) were crossed with the CVC target-like productions in the picture-naming task and this time the correlation reached statistical significance.

4.6 Summary of the results and final comments

In light with predictions about CVC-final stops production made according to markedness relations in terms of voicing and place of articulation, and about the relationship between these stops perception and production made according to previous literature (e.g., Flege, 1995, Koerich, 2002), the investigation and the statistical analyses performed in this chapter allowed the following insights reported bellow.

Regarding the investigation of Hypothesis 1, the overall results supported the prediction about the use of simplification strategies and statistical analyses yielded a significant preference for the use of epenthesis over deletion. This tendency was explained with the recoverability principle, since participants had some knowledge of the L2 vocabulary involved in the tests. In fact, participants seemed to have tried to maintain the meaning of words, avoiding ambiguity by choosing to keep the final stop and resorting to the addition of the epenthetic vowel instead of deletion of the final consonant.

Furthermore, consonant modification strategies were found in the dataset and

significance was reached favoring aspiration over devoicing and over fronting. Furthermore, epenthesis and aspiration were analyzed and the results yielded significance for aspiration over epenthesis, indicating that this sample had a stronger tendency to apply an L1 transfer strategy in terms of allophonic variation, than in terms of syllabic pattern. In addition, it seems that task type affected the results significantly, showing a tendency for more target-like productions in the imitation task than in the free speech task (picture-naming). The discussion of task type effect is not part of the present study; however, the data is available for further investigations.

Subsequently, the investigation of Hypothesis 2 concerning the relation between target-like productions and voicing of the target stops showed the opposite order from the one posted by the MDH. In spite of the very close rates, which did not yield significant results, there was a tendency for voiced stops to be less frequently modified. As an attempt to compare the results of the present study with those from previous ones in relation to voicing and occurrence of epenthesis, the instances of epenthesis were analyzed separately from the other types of mispronunciations and although the percentage rates were higher for voiced stops, statistical significance was not reached either.

The influence of markedness by place of articulation was investigated in Hypothesis 3, and the results here did not support the hypothesis, since the alveolars were the targets with most mispronunciations of three places of articulation. In general terms, the bilabials presented more target-like productions than the velars, and then the alveolars, which were greatly aspirated. Furthermore, the investigation regarding markedness in terms of place of articulation and epenthesis production offered a totally different tendency, where the bilabials received more epenthetic vowels, followed by the

alveolars and finally the velars, with less occurrence number of epenthetic vowels.

Finally, Hypothesis 4 aimed at investigating the correlation between perception and production abilities. This correlation was investigated in terms of perception data gathered through an AX discrimination task and production data from a picture-naming task. The mean rate obtained in the discrimination test (52.68%) indicates that participants had difficulty in discriminating the pairs. Besides that, no significant correlation was found between the datasets from perception and production. A further investigation of the correlation between speech perception and production involved data from the imitation task (as perception) and the picture-naming tasks, and this time the correlation was found to be statistically significant.

The analysis of the correlation between the results from the imitation and picture-naming tests indicated that both tests showed to be reliable tools to collect speech production data, in other words, that production could be assessed by either imitation or production and that the results would be quite similar. Therefore, when the results from the imitation test were analyzed as perception data they truly corresponded to the participants' production abilities. On the other hand, the investigation on the correlation between the AX discrimination and the picture-naming tests (*rho* (12) = .39, p = .206) indicated a mild correlation, in contrast to the level of correlation found between the imitation and the production results which was median to high (*rho* (12) = .70, p = .011). These findings reinforce the idea that imitation does not measure true perceptual sensitivity.

In view of what was said before, despite the individual variations as shown in the tables in Appendix C, as well as variations concerning task type, the fact that all the participants have the same L1 and belong to the same age range seemed to have indicated

possible tendencies for young BP learners of English as foreign language. In terms of production, the present sample seems to have a tendency to resort to modification strategies when the target is a final stop. Regarding perception, the discrimination between CVC and CVC words can be considered poor, once the mean rate (52.68%) was close to 50%, this small difference indicates poor correlation (Flege et al., 1999).

As in previous studies investigating speech perception and production, individual variations also seemed to play an important role in this study, thus making it difficult to identify strong tendencies and to claim about the roles played by the specific variables investigated in the present study.

CHAPTER 5

CONCLUSION

5.1 Theoretical implications

Two main objectives guided this thesis (1) the investigation of the variables of markedness, regarding syllable type, voicing and place of articulation in relation to production of the final stops in isolated CVC units represented by monosyllabic words, and (2) the analysis of the relationship between perception and production of the target stops by analyzing the correlation between the A' Prime scores and the CVC target-like outputs from the picture-naming test and by analyzing the correlation between the results of the imitation, representing perceptual ability, and the picture-naming test. The major goals were to see whether the tendencies of production and the type of correlation between perception and production observed in the present study would corroborate the tendencies found in the outcomes of previous studies accounting for the interphonology of adult BP learners of English (Baptista & Silva Filho, 1997; Koerich, 2002; and Silveira, 2004).

Following Koerich (2002), the investigation of markedness relations is underpinned on previous research and theoretical developments of Eckman (1977/1987a), Weinberger (1987), Yavas (1994/1997) and Flege (1995), among others. Eckman's Markedness Differential Hypothesis (MDH) proposes that L2 forms that are both new and more

marked than forms in the L1 will be more difficult to acquire and that the degree of markedness will indicate the degree of difficulty. When investigating BP/English interlanguage phonology, specifically the final stops, the prediction is that simplification strategies will be applied at some degree once this final consonant is more likely to be interpreted as the onset of a new syllable. Weinberger proposes the Ontogeny Model of phonological development and explains that, regarding syllable simplification strategies applied by FL learners, it should be expected that at an early stage of acquisition transfer strategies may suppress developmental processes and with time the rate of these strategies show the opposite order. Yavas studies contributed to the effects of markedness on L2 final consonant production in relation to place of articulation and that velars would pose more difficulty than alveolars and bilabials. Flege's Speech Learning Model (SLM) refers to perception preceding production and that the formation of new L2 categories in the learners' interphonology eventually occurs, leading to a more target-like pronunciation.

As presented in the previous chapter, the results of the present study confirmed Hypothesis 1 since it was found a great number of simplification strategies in the dataset. According to Major's Ontogeny Model, L1 transfer strategies were very recurrent (palatalization MS = 54.84% and epenthesis MS = 13.44%), since the addition of both mispronunciations totalize 68.28%, whereas the mispronunciations due to developmental processes (devoicing MS= 9.64%, deletion MS= 0.53% and fronting MS= 0.63%) make a total of 10.80%. The overall view of the dataset showed that individual differences were also high, indicating an asymmetric distribution.

Therefore, it seems that transfer strategies were very recurrent in the production dataset, which corroborates Weinberger's idea of having L1 transfer strategies applied to

more marked forms at a first stage of the acquisition of an L2 sound system. In addition, Koerich's study investigating epenthesis in BP/English interlanguage of students in the first and second semesters of instruction, that is, in the beginning of L2 learning, found 44.45% of epenthesis in the overall production of final consonants. This finding also corroborates Major's Model. In short, in terms of interphonology tendencies the population tested here already makes use of their L1 knowledge in the process of acquiring the final stops in the CVC words in a target-like fashion.

The results of this study did not seem to support the prediction made for Hypothesis 2. Contrarily to the markedness predictions of voiced targets being more difficult than voiceless ones, the population tested in this study reached a higher score of target-like productions for the voiced than for the voiceless stops. Nevertheless, in the individual analysis of the percentage rates by participant (Appendix C), it was observed that 6 out of twelve participants followed the tendency predicted by the MDH; however the difference between the voiced and voiceless scores were quite similar.

The investigation of the relative markedness among voiced stops in relation to their voiceless counterparts by place of articulation yielded results that partially supported hypothesis three. The overall rates of mispronunciation corroborated studies where the bilabials were the least difficult stops. On the other hand, in the present study neither the the alveolars nor the velars followed the expected order of markedness, once the alveolars were the targets with most of the mispronunciations and according to the investigation, this low rates of target-like productions for the alveolar stops were due to L1 transfer, that is palatalization, which was broadly applied to these phonemes as they often are in BP where the alveolars are followed by /i/ (e.g. [, meaning 'milk' and [,

meaning ‘goat’). In addition, when the rates of epenthesis were classified according to place of articulation, the rank for target-like productions was again different from the prediction. Surprisingly the bilabials were the stops with more epenthesis than the velars and the alveolars subsequently.

Concerning the relationship between perception and production, cross-language speech research has interpreted empirical data in three possible ways: that perception precedes production that the two abilities develop concomitantly, and that production precedes perception. However, the idea that production develops independently from perception seems quite unnatural, as the learner should first have some amount of language experience before being able to transform an idea into an acceptable linguistic and phonological form with which s/he conveys meaning and actually communicates ideas. In addition, articulatory constraints can also hinder proper phonetic production, which does not mean poor perceptual ability.

Thus, investigating perception via production outputs (i.e. using the imitation dataset as indicative of perception sensitivity) can mislead the findings; hence a specific perception test was used to collect data to be compared with the dataset from the imitation test, aiming to have a possible confirmation of the correlation found. However, a weak and non-significant correlation was found between the results of the AX discrimination test with the picture-naming test, whereas there was a moderate, significant and positive correlation between the results of the imitation and production tests. Thus, the former pair of analysis supported the prediction that perception precedes production but not the later.

The individual analysis of the participants’ A’ Prime and picture-naming scores, as well as the imitation and free-production scores showed that, in both analysis, eleven out

of twelve participants followed the expected pattern, although not always the rates were expressively different. Interestingly, the differences in the rates from the imitation and production tests seemed to be more consistent than the differences in the first correlation (Ax test vs. picture-naming test).

Nevertheless, In the discrimination test, participants appeared to be quite unsure whether the CVC unit was different from the CVC , for it seemed their perception accounted more for semantic meaning than for the unit of representation (that is, the syllabic pattern being tested), and they did not recognize them as semantically different. Therefore, they did not show to have developed proper sensitivity towards the syllable type in the TL yet. In fact, for BP speakers the CVC unit is more marked than their preferred CV pattern and due to their little knowledge of the TL, transfer strategies are quite recurrent when they face the more marked syllable in the TL.

Since the sample gathered in this study showed great use of L1 transfer, the investigation of the effect of age and target-like perception and production indicates two possible explanations; either the participants were already too old to have access to the UG and therefore they used their L1 knowledge to perceive and produce the L2 words, or the UG is actually not accessible at all to L2 learners, independently of the age they are exposed to the target language. Thus, further studies investigating simultaneous bilinguals that are learners of English as second language (ESL), or younger EFL learners could contribute to this discussion.

To summarize, language learners tend to simplify marked forms and they can do it by applying different simplification strategies. The relative degree of markedness relations between the languages in contact, as well as L1 transfer and the individual

constraints are the main elements that influenced the variations in the learners' outputs. Therefore, when investigating the acquisition of an L2 it is crucial that these aspects are accounted in the attempt to explain variations found in speakers' productions that do not follow into the expected patterns.

5.2 Pedagogical implications

Nowadays, discussions on L2 acquisition and the mental processes activated when linguistic information is stored or retrieved are supported by theoretical and empirical developments reached from empirical investigation throughout the last decades. As the starting point of building a linguistic system, it is the formation of linguistic representations and the conditions and forms in which these representations are stored and retrieved in terms of perception and production performance.

The results of the present study showed that participants still lack the appropriate cues on which perception and production of the final stops are built up. Their unit of perception seemed not to be sensitive enough to distinguish the necessary L2 cues for the final stops due to the activation of the L1 parameters. The production of the participants also deviated from the L2 norm and approximated the L1 norm, again indicating that the L2 retrievals happened via L1. Therefore, there is primordial need to help learners improve and modify the present stage of the interlanguage phonology towards the target language. The participants need to be provided with quality and quantitative input once the new system can only be established through language exposure (Gass, 1997), helping

learners acquire the L2 cues they have shown to lack – the distinction of final-stops versus a stop followed by /i/.

By knowing which rules are more likely to operate in a certain IL, which is only possible by empirical research through the analysis of the languages in contact and their relative markedness relations, it becomes more possible to predict which errors are more likely to occur. In practical terms this understanding is quite important for the elaboration of techniques for teaching and assessing language learners' development. Once markedness relations between the languages in contact were identified, teachers become empowered with tools to assess and assist their students and are able to not only focus on the more difficult areas of learning in a more effective and conscious way, but also, specifically for young learners, to distinguish possible language disorders from natural variations related to the degree of markedness between the two systems and the learner's individual speech characteristics and variations in the course of language learning.

The starting point to work with the development of a L2 sound system should be to focus on the most probable mispronunciations and to help learners avoid the non target-like outputs in order to prevent fossilization. In general terms, whenever possible, pause should be avoided after final consonants to prevent the epenthetic vowel to be added to the coda or the overaspiration of the target stops. In addition, perceptual ability has to be developed by raising phonological awareness through training for both young and adult learners. Nevertheless, it is training that will eventually make such practice automatized, thus acquired, preventing fossilization of inappropriate L2 items which are highly resistant to modification due to L1 parameters being used as cues for TL items (Koerich, 2002). More specifically, as a result of this study investigating BP/English

interphonology, the final stops and the perceptual discrimination of CVC and CVC should be trained since the first stages of L2 instruction.

Summing up, the pedagogical application of this study is providing EFL teachers and teacher trainers with empirical findings in relation to the possible variations in BP/English interphonology. The present research offers data, collected from young Brazilian learners of English, on the ability to perceive and produce the six final-stops in a more marked syllable structure than their L1 preferred syllable type. The results here can enrich discussions about the types of speech variation in the learners' interphonology at an early stage of L2 acquisition, helping teachers to better assess their learners' L2 system both in terms of perception and production, as well as to provide a comparison of young and adult learners' most preferred strategies based on cross-language markedness relations. With a broader view of the mental and phonological processes activated during L2 acquisition by different age groups with the same L1, specific pedagogical tools, materials and techniques can be developed, which showed to keep the focus on the real difficulties of the learners, thus promoting more effective L2 lessons and reaching students' major needs, hence improving effectively their L2 phonetic and phonological skills and making the L2 instruction time more effective in terms of perception and production.

5.3 Limitations and suggestions for further research

Despite the great effort to account for extraneous variables and details that could have biased the results, this study presents some limitations to be accounted for, concerning the methodology used here. On the other hand, aiming to contribute with further research on the perception and production of English final-stops, some insights will be put forward.

The major limitations of this study are: (1) the small number of participants; (2) the small number of outputs for each of the targets; (3) the fact that the final-stops were followed by pause, thus promoting a different type of release which does not correspond to the release in connected speech; (4) the little knowledge of the participants' L1 speech traces, which would allow a deeper investigation about the individual level; (5) the lack of empirical data on the interlanguage of young Brazilian learners of English; and, (6) the limited statistical analysis.

These constraints somehow restricted the depth of the discussion of the results into a description of speech variation and perceptual sensitivity. On the other hand, interesting information was gathered and allowed the identification of some tendencies in the participants' interphnology and about the correlation between L2 production and

perception of the final stops. In addition, the investigation promoted insights about the differences between the interlanguage phonology of BP children and adults, which actually seemed quite similar. It seemed that at the age the present participants were their L2 speech was very much influenced by their L1 phonetic and phonological knowledge.

Specifically for the investigation of the palatalization of the alveolars, it seemed important to have collected data of their L1 idiolect to try to trace a dialectal pattern in their speech and also enrich the discussion of individual variations based on L1 background. This piece of information could have contributed to the explanation of why certain strategies were more or less used than others by each participant. In this case a comparison between participants' L1 words and L2 target outputs with the alveolar stops could be of great value to explain individual variation and amount of palatalized instances.

In addition, the limited number of participants reduced the amount of data collected to investigate each of the four hypotheses, thus making it difficult to find strong statistical support for the patterns of acquisition observed in the dataset. Such limited number of tokens was also due to the participants' little vocabulary knowledge considering the characteristics of the sample and their instruction time (Appendix A). Even though they had had at least 3 semesters of instruction, since they all had little linguistic knowledge and language experience if compared to adults, their linguistic abilities take longer to develop and at the early stages of L2 acquisition they have limited vocabulary knowledge.

In order to select participants at a similar stage of linguistic development (i.e. with the same amount of exposure to the TL, and at the same school grade) and age, three participants had to be discarded from the group. Thus, data from only 12 participants

could be used, limiting the statistical analysis into tests used for non-parametric type of data. Nevertheless, some participants were analyzed individually with the objective to show how speakers can perform differently from one another, even though they are part of quite a selected group considered to be as homogeneous as possible. Due to the limited number of participants it was not possible to observe a direct relation between starting age, testing age or time of instruction neither in the participants' perception sensitivity nor in their variations in production.

Furthermore, task type seemed to have interfered much more than the individual variables just mentioned in the production of final stops in CVC units. As previously explained, the more formal task, imitation, had yielded higher rates of target-like outputs. The imitation test works as an exercise in the classroom for teaching vocabulary and training pronunciation, whereas the production task is more likely to reflect the learners' spontaneous speech. Through the comparison between the scores obtained in the perception test and the imitation test as an indicator of production, it became possible to say that the imitation test may be a good instrument to measure production ability in articulatory terms, at least when the participants have a limited vocabulary knowledge in the TL, as it was the case here. If the imitation test was not applied in this study, very few instances would have been gathered to investigate participants' interphonology, since it functioned as a vocabulary familiarization task. In addition it was used to measure perception as well.

Even though the present study has offered new and relevant results in relation to the interphonology of BP learners of English, there are still many issues which need to be empirically investigated and theories to be tested in various aspects. First, an interesting

topic is whether training of the targets would have carry over effects on learners' pronunciation. Second, the learning environment is another variable which can influence the development of L2 perception and production, thus comparing EFL with ESL learners is another possible extension of the present research. Third, the investigation on the variations in learners L1 dialect and their L2 speech characteristics is quite relevant to the field as well, once L1 transfer has strongly influenced learners' interphonology – having groups from different dialectal regions could help explain why certain strategies are more used than others. Last, the obstruents have also been investigated in relation to syllable position and phonological environment and showed to interfere in perception and production of L2 items, thus a more complete analysis is extremely important to picture the BP/English interphonology in a more detailed manner. Nevertheless, the present study has given serious continuation to the on going investigation of perception and production of the English-final stops and has added up to the discussion of age and L2 learning.

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APPENDICES

Appendix A

PARTICIPANTS' PROFILE AND INDIVIDUAL AND MEAN SCORES

Participant	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Mean
Starting age (years/months)	3/11	3/11	4	4/7	2/11	3/11	2/8	2/11	3/01	2/08	2/11	2	**3/4**
Testing age (years/months)	5./6	5/6	5/7	6/2	5	5/6	5/3	4/6	4/3	5/10	5	4/8	**5/2**
Instruction Time semesters	4	4	4	4	5	4	6	3	3	7	5	6	**4 ½**
School grade	I4	I5	I5	I6	I2	I5	I2	I1	I1	I3	I2	I1	
Pe Score Hit/catch trial	17/3	16/32	17/32	17/32	18/32	26/32	24/32	16/32	20/32	17/32	21/32	17/32	
A' Prime scores	50.1	50	50.1	50.1	50.4	65.8	60.4	50	51.9	50	53.2	50.1	**52.68**
Perception test Response Time	7'30''	9'45''	8'30''	6'40	7'45"	5'30''	5'20''	6'	10'	8	7'40''	5'40"	**7'30"**
Imitation test Response Time	1'45	2'15''	1'15''	2'10''	1'40''	1'50''	1'30''	3'30''	2'40''	'1'20''	2	1'55''	**1'40''**
Imitation Target-like %	21.05	85.29	15.63	61.11	56.25	41.94	76.67	55.17	86.21	68.97	93.10	42.86	**57.55**
Production test Response Time	2'50	2'50''	3'	2'50''	3'	2'40''	2'30''	4'10''	3'50''	2'25''	2'10	3'15''	**2'40''**
Production Target-like %	0	78.57	18.75	8.33	26.67	23.53	35.29	17.65	44.44	15.79	88.89	0	**31.72**
Production epenthesis %	80	0	12.50	0	33.33	5.88	23.53	29.41	0	0	0	69.23	**13.44**
Production deletion %	0	0	0	0	0	5.88	0	0	0	0	0	0	**0.53**
Production aspiration %	40	21.43	75	91.67	46.67	64.71	41.18	58.82	55.56	84.21	11.11	69.23	**54.84**
Production devoicing %	0	40	12.50	14.29	0	12.50	0	14.29	22.22	0	0	0	**9.64**
Production fronting %	0	0	0	0	0	7.14	0	0	0	0	0	0	**0.63**

The strategies found in the dataset were counted individually, thus there is more variation than instances of output. Therefore, the total number of strategies indicates the number of instances of strategies applied.

Appendix B

TESTS CONTENT

Imitation and Production ***Date:***

Name: **Birth:**

TB admission: **Family background:**

Regular school: **Grade**:

Perception Test score and MD track:

Imitation				**Production**			
	Key	**Answer**	**Notes**		**Key**	**Answer**	**Notes**
01	Sheep			**01**	Lab		
02	Foot			**02**	Book		
03	Book			**03**	Cap		
04	Tub			**04**	Head		
05	Bed			**05**	Cat		
06	Pig			**06**	Bed		
07	Bag			**07**	Foot		
08	Red			**08**	Sheep		
09	Lab			**09**	Bag		
10	Duck			**10**	Web		
11	Cat			**11**	Dog		
12	Cap			**12**	Duck		
13	Soup			**13**	Bag		
14	Hat			**14**	Lab		
15	Sock			**15**	Foot		
16	Bib			**16**	Sheep		
17	Head			**17**	Cat		
18	Dog			**18**	Duck		
19	Leg			**19**	Head		
20	Sad			**20**	Bed		
21	Web			**21**	Dog		
22	Neck			**22**	Book		
23	Boot			**23**	Cap		
24	Map			**24**	Web		

Appendix C

TABLES WITH NUMBER OF PRODUCTIONS AND CORRESPONDENT PERCENTAGE SCORES BY PARTICIPANT

HYPOTHESIS 1 – Simplification Strategies

Table 1.1
Number of tokens modified by simplification strategies by participant

	Epenthesis	Deletion	Aspiration	Devoicing	Fronting
S1	6/10	0/10	4/10	0/5	0/10
S2	0/14	0/14	3/14	2/5	0/12
S3	2/16	0/16	12/16	1/8	0/13
S4	0/12	0/12	11/12	1/7	0/12
S5	4/15	0/15	7/15	0/8	0/13
S6	1/17	1/17	11/17	1/8	1/14
S7	4/17	0/17	7/17	0/5	0/13
S8	4/17	0/17	10/17	1/7	0/15
S9	0/18	0/18	10/18	2/9	0/15
S10	0/19	0/19	16/19	0/8	0/16
S11	1/18	0/18	2/18	0/7	0/14
S12	4/13	0/13	9/13	0/6	0/11
Nº of Strategy	25/186	1/186	102/186	8/83	1/158

* For instance1/4, means that the participant produced 1 instance out of four.

Table 1.2
Percentage rates of simplification strategies applied by participant

	Epenthesis	Deletion	Aspiration	Devoicing	Fronting
S1	60	0	40	0	0
S2	0	0	21.43	40	0
S3	12.50	0	75	12.50	0
S4	0	0	91.67	14.29	0
S5	26.70	0	46.67	0	0
S6	5.88	5.88	64.71	12.50	7.14
S7	23.53	0	41.18	0	0
S8	23.53	0	58.82	14.29	0
S9	0	0	55.56	22.20	0
S10	0	0	84.21	0	0
S11	5.5	0	11.11	0	0
S12	30.77	0	69.23	0	0
% of Strategy	13.44	0.53	54.84	9.64	0.63

Table 3.2
Percentage rates of devoicing and epenthesis in both tasks by participant

	Epenthesis Imitation	Epenthesis Picture-naming	Devoicing Imitation	Devoicing Picture-naming
S1	39.47	60	10.53	.00
S2	.00	.00	26.32	40
S3	31.25	12.50	6.25	12.50
S4	.00	.00	52.94	14.29
S5	21.88	26.70	.00	.00
S6	6.45	5.88	12.50	12.50
S7	6.67	23.53	16.67	.00
S8	34.48	23.53	6.25	14.29
S9	3.45	.00	57.14	22.20
S10	3.45	.00	37.51	.00
S11	.00	.00	5.88	.00
S12	31.43	30.77	5.56	.00
% of Strategy	14.85	13.44	19.79	9.64

HYPOTHESIS 2 – Markedness relations in terms of voicing

Table 4.1

Number of tokens of CVC target-like outputs by voicing

	Voiced				Voiceless			
	/p/	/t/	/k/	*Total*	/b/	/d/	/g/	*Total*
S1	0/0	0/3	0/2	0/5	0/0	0/1	0/4	0/5
S2	2/2	3/4	2/3	7/9	0/0	1/1	3/4	4/5
S3	0/2	0/3	0/3	0/8	0/1	0/3	3/4	3/8
S4	0/0	0/2	0/3	0/5	0/0	1/3	0/4	1/7
S5	0/0	0/4	2/3	2/7	1/2	0/2	1/4	2/8
S6	1/2	0/3	0/4	1/9	1/1	0/3	2/4	3/8
S7	3/4	0/4	1/4	4/12	0/0	0/1	2/4	2/5
S8	1/2	0/4	1/4	2/10	0/0	1/4	0/3	1/7
S9	1/1	1/4	2/4	4/9	2/2	1/3	1/4	4/9
S10	2/3	0/4	0/4	2/11	0/0	0/4	1/4	1/8
S11	3/3	2/4	4/4	9/11	1/1	3/3	3/3	7/7
S12	0/2	0/3	0/2	0/7	0/0	0/2	0/4	0/6
Nº Productions	13/19	6/42	12/42	31/103	5/7	7/30	16/46	28/83

Table 4.2

Percentage rates of CVC target-like outputs by voicing

	Voiced				Voiceless			
	/p/	/t/	/k/	*Total*	/b/	/d/	/g/	*Total*
S1	0	0	0	0	0	0	0	0
S2	100	75	66.70	77.78	0	100	75	80
S3	0	0	0	0	0	0	75	37.50
S4	0	0	0	0	0	33.34	0	14.28
S5	0	0	66.70	28.57	50	0	25	25
S6	50	0	0	11.11	100	0	50	37.50
S7	75	0	25	33.33	0	0	50	40
S8	50	0	25	20	0	25	0	14.28
S9	100	25	50	44.45	100	33.34	25	44.44
S10	66.70	0	0	18.18	0	0	25	12.50
S11	100	50	100	81.81	100	100	100	100
S12	0	0	0	0	0	0	0	0
% Productions	68.42	14.28	28.57	30.10	71.43	23.35	34.78	33.73

Table 5.1

Percentage rates of epenthesis by voicing

	Voiced				Voiceless			
	/b/	/d/	/g/	*Total*	/p/	/t/	/k/	*Total*
S1	0	100	100	100	0	33,35	100	60
S2	0	0	0	0	0	0	0	0
S3	100	0	25	25	0	0	0	0
S4	0	0	0	0	0	0	0	0
S5	50	0	75	50	0	25	0	14.28
S6	0	0	25	12.50	0	0	0	0
S7	0	100	50	60	25	0	0	8.34
S8	0	25	66,65	42.85	50	50	0	30
S9	0	0	0	0	0	0	0	0
S10	0	0	0	0	0	0	0	0
S11	0	0	0	0	0	0	0	0
S12	0	100	25	33.34	100	100	50	85.71
% Epenthesis	28.57	16.65	30.43	24.09	21.05	16.65	7.14	13.59

HYPOTHESIS 3 – Markedness relations in terms of place of articulation

Table 6.1
Number of CVC target-like output per participants by place of articulation found in the production test

Place of Articulation	% Bilabials			% Alveolar			% Velar		
Phoneme	/p/	/b/	Total	/t/	/d/	Total	/k/	/g/	Total
S1	0/0	0/0	0/0	0/3	0/1	0/4	0/2	0/4	0/6
S2	2/2	0/0	2/2	3/4	1/1	4/5	2/3	3/4	5/7
S3	0/2	0/1	0/3	0/3	0/3	0/6	0/3	3/4	3/7
S4	0/0	0/0	0/0	0/2	1/3	1/5	0/3	0/4	0/7
S5	0/0	1/2	1/2	0/4	0/2	0/6	2/3	1/4	3/7
S6	1/2	1/1	2/3	0/3	0/3	0/6	0/4	2/4	2/8
S7	3/4	0/0	3/4	0/4	0/1	0/5	1/4	2/4	3/8
S8	1/2	0/0	1/2	0/4	1/4	1/8	1/4	0/3	1/7
S9	1/1	2/2	3/3	1/4	1/3	2/7	2/4	1/4	3/8
S10	2/3	0/0	2/3	0/4	0/4	0/8	0/4	1/4	1/8
S11	3/3	1/1	4/4	2/4	3/3	5/7	4/4	3/3	7/7
S12	0/2	0/0	0/2	0/3	0/2	0/5	0/2	0/4	0/6
Nº Productions	13/21	5/7	18/28	6/42	7/30	13/72	12/40	16/46	28/86

Table 6.2
Percentage of CVC target-like output per participants by place of articulation found in the production test

Place of Articulation	% Bilabials			% Alveolar			% Velar		
Phoneme	/p/	/b/	Total	/t/	/d/	Total	/k/	/g/	Total
S1	0	0	0	0	0	0	0	0	0
S2	100	0	100	75	100	80	66.67	75	71.42
S3	0	0	0	0	0	0	0	75	42.85
S4	0	0	0	0	33.33	20	0	0	0
S5	0	50	50	0	0	0	66.67	25	42.85
S6	50	100	66.7	0	0	0	0	50	25
S7	75	0	75	0	0	0	25	50	37.5
S8	50	0	50	0	25	12.5	25	0	14.28
S9	100	100	100	25	33.33	28.57	50	25	37.5
S10	66.67	0	66.7	0	0	0	0	25	12.5
S11	100	100	100	50	100	71.42	100	100	100
S12	0	0	0	0	0	0	0	0	0
% Productions	61.90	71.42	64.28	14.28	23.34	18.05	30	34.78	32.56

APPENDIX D

ACQUISITION OF THE BRAZILIAN-PORTUGUESE STOPS BY AGE

	1:0	*1:1*	*1:2*	*1:3*	*1:4*	*1:5*	*1:6*	*1:7*	*1:8*	*1:9*	*1:10*	*1:11*	*2:0*	*2:2*
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Adapted from Lamprecht 2004, p.169

Appendix E

UNIVERSIDADE FEDERAL DE SANTA CATARINA
CENTRO DE COMUNICAÇÃO E EXPRESSÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM LETRAS/INGLÊS E LITERATURA CORRESPONDENTE

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título da Pesquisa: *Percepção e produção das obstruintes finais por crianças brasileiras estudantes de inglês*

Pesquisadora: Violeta Arantes
Orientadora: Prof. Dra. Rosana Denise Koerich

Prezados pais,

Esta carta convida seu/sua filho/a para participar de um projeto de pesquisa sobre o desenvolvimento da percepção e produção de língua estrangeira. O projeto faz parte de minha pesquisa para tese de mestrado no programa de.pós graduação em inglês, sob a orientação da Prof. Dra. Rosana Denise Koerich. O convite se deve ao fato de seu/sua filho/a estar em processo de desenvolvimento das habilidades de percepção e produção da fala em inglês. Por favor, leia este consentimento e, se concordar, assine onde indicado.

Objetivo do Estudo: O objetivo maior deste estudo é fornecer subsídios para a extensão de um modelo de aprendizagem da fala em língua estrangeira. Estudos semelhantes têm sido conduzidos com adultos. Pretendo aprofundar as discussões, disponibilizando à comunidade acadêmica, dados sobre crianças aprendizes de inglês como língua estrangeira.

Procedimentos: A participação de seu/sua filho/a se dará da seguinte maneira: (1) a pesquisadora assistirá algumas aulas da professora regular na turminha da Teddy Bear para se familiarizar com os alunos e para que os mesmos a conheçam e sintam-se à vontade para realizar as tarefas da pesquisa; (2) a pesquisadora aplicará os testes em sessões individuais de 10 a 15 minutos, durante o período de aula, nas dependências da escola. Os dados serão colhidos através de gravação em áudio, utilizando-se um "joguinho" de computador e um fone com microfone.

Software: Os dados de percepção e produção da fala em língua estrangeira serão colhidos através do software desenvolvido para motivar a criança a identificar e produzir os sons-alvo em palavras familiares. As três etapas do software são baseadas em

atividades utilizadas na escola em situação regular de aula com alunos da faixa etária de seu/sua filho/a.

Riscos e benefícios do estudo: Não há riscos em participar deste estudo. Como dito acima, as crianças serão convidadas a participar de atividades utilizadas em situação regular de sala de aula de língua estrangeira. O/a participante será convidado a fazer as atividades e a qualquer momento poderá se desligar do projeto por vontade própria ou de seus responsáveis, sem precisar se justificar. O estudo é de natureza quantitativa e os resultados serão tornados públicos através de dados numéricos. A identidade do/a participante (e do/da responsável) será totalmente preservada não sendo incluída nenhuma informação que possa identificá-lo/la. Somente a pesquisadora e sua orientadora acadêmica terão acesso aos dados individuais coletados.

Natureza voluntária do estudo: Sua decisão de permitir ou não a participação do/a seu/sua filho/a neste estudo não irá afetar você ou sua relação com a Universidade de nenhuma forma.

Contatos:
Pesquisadora - mestranda Violeta Toledo Piza Arantes
violeta_toledo@hotmail.com
Tel: 234-6889
Orientadora: Profa Dr. Rosana Denise Koerich.
rkoerich@matrix.com.br
Tel: 331-9288 ou 331-9703 (Sala no. 105, Prédio B CCE/UFSC)

Declaração de Consentimento Pós-Informação:
Declaro que li as informaçôes acima. Quando necessário, fiz perguntas e recebi esclarecimentos. Concordo que meu/minha filho/a participe do projeto de pesquisa *Percepção e Produção das Plosivas Finais por Crianças Brasileiras Estudantes de Inglês*, e concordo que os dados de meu/minha filho/a sejam utilizados na realização da mesma.

Nome legível do/da participante:

Tempo de instrução de inglês:

Nome legível do/da responsável:

RG do/da responsável:

Assinatura da orientadora:

Assinatura da pesquisadora responsável:

Assinatura do/da responsável:

Data: _____Uma cópia com a pesquisadora e outra com o responsável.