THE ACQUISITION OF FINE PHONETIC DETAIL IN A FOREIGN LANGUAGE

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Dissertation Proposal

Second Language Acquisition and Teaching (SLAT)

University of Arizona

September 14th, 2014

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CHAPTER 1 - OVERVIEW AND MOTIVATION

1.1. Introduction

This study concerns the acquisition of English VOT categories in word-initial stops /p b k g/ by adult Brazilian Portuguese second language (L2) learners, who have learned English in a formal context. The investigation focuses on the perception and production of voice onset time (VOT).

VOT is defined as the temporal distance between the release of the stop closure and the onset of glottal vibration of the following vowel (Lisker & Abramson, 1964). VOT can have negative and positive values. VOT is negative if voicing starts before the release (called voicing lead or prevoicing). VOT is positive if it occurs after the release (called voicing lag), which can be a short-lag VOT (voiceless unaspirated stops – phonation begins at or close to the stop release) or a long-lag VOT (voiceless aspirated stops – there is a considerable delay between the stop release and the onset of the vibration of the vocal folds).

In English, VOT has been shown to be a source of difficulties for learners of English in many languages, such as Italian, French and Spanish since their first languages have VOT values that differ from those in English (e.g., MacKay, Flege, Piske, & Schirru, 2001; García-Sierra, Diehl & Champlin, 2009). VOT categories are phonetically different in Portuguese and in English as well. Although Portuguese and English contrast stops with the same phonological category (voiced and voiceless), speakers use different phonetic categories to differentiate them: In initial position, English /b d g/ can be realized with both lead and, more commonly, with short-lag VOT values. Therefore, English /b d g/ are phonologically voiced stops, but phonetically voiceless stops. English

/p t k/ is realized with long-lag VOT values (e.g., Lisker & Abramson, 1964; Klatt, 1975; Cho & Ladefoged, 1999). In Portuguese, speakers prevoice /b d g/, and produce /p t k/ with short-lag values (e.g., Major, 1987; Klein, 1999; Cohen, 2004).

VOT is important for L2 learners since timing is a major cue to distinguish voiced and voiceless stops (e.g., Lisker & Abramson, 1964). Brazilian Portuguese learners of English, for instance, tend to produce English /p t k/ with short VOT, which demonstrate their lack of phonetic categorization (e.g., aspiration) for the English stops (e.g., Cristófaro Silva, 2005; Zimmer, Silveria, & Alves, 2009). This difficulty that Brazilian Portuguese learners of English have regarding the production of English stops can potentially cause miscommunication or communication breakdown (Zimmer, 2004; Zimmer, Silveira, & Alves, 2009) (e.g., the word /pɛt/, pronounced by L2 learners, can be understood as /bɛt/).

On the other hand, English /b d g/ and Portuguese /b d g/ can both be realized with lead VOT values (more rare in English, but acceptable). Therefore, the potential lack of communication problems with English /b/, for instance, could result in less pressure for L2 learners of English to establish new phonetic categories for these sounds (MacKay et al., 2001). Production and perception might then be affected, contributing to L2 learners' poor performance since L2 learners of English, especially adults, are not always sensitive to these relevant, but fine-grained differences (e.g., Imai, Walley, & Flege, 2005).

The acquisition of L2 English VOT categories is, therefore, an interesting and a relevant area of investigation. In order to better understand the acquisition of L2 VOT values, this study aims to investigate L2 production and perception by Brazilian

Portuguese learners of English, who had learned English in formal settings. Below, the main goals of this study are discussed, followed by the research questions.

1.2. Goals and Research Questions

There are four main goals in this study:

1. *Production.* This study analyzes the L2 production of English VOT categories in words with initial stops /p b k g/ (data which I have already collected). Comparisons of L2 production across lower and higher-proficiency groups will be conducted. These comparisons will demonstrate whether higher-proficiency group shows learning progress toward the target phonemes (e.g., Does general improvement in L2 language entail improvement in production of VOT categories?). In addition, comparisons between L2 English and L1 Portuguese production of VOT category will be conducted. These comparisons will demonstrate whether differences in production between the lower and higher learner groups are due to the formation of new categories. This part of the study will contribute to the area of L2 acquisition of VOT categories inasmuch as it expands the growing body of research that seeks to understand the acquisition of stops by adult learners of English as a foreign language.

2. *Perception.* The second goal of this study is to investigate the formation of language-specific perceptual systems by L2 adult learners (data which I have already collected). This part of the study will compare L2 learners' perception of English word-initial /p b/ between lower and higher-proficiency learners. In addition, it will compare the perception of L1 Portuguese between L2 learners of English and monolingual Brazilian Portuguese speakers. This analysis will answer whether L2 learners have

formed separate categories for their L2 perception. Although language-specific perceptual systems have been found in early, fluent bilinguals, it is unknown whether late L2 learners are also able to develop language-specific perceptual systems. This study will, therefore, provide important contributions to the understanding of L2 phonemic representations of sounds.

3. *Phonetic Drift.* A third goal of this study is to investigate whether L1 Portuguese perception and production are influenced by L2 knowledge (data which I have already collected). The perception and production of Portuguese stops in initial position produced by monolingual Brazilian Portuguese speakers will be analyzed, and then compare with the perception and production of Portuguese by L2 learners. This analysis will reveal whether knowledge of VOT categories in L1 and L2 has asymmetrical influences (e.g., only L1 influences L2), or whether it is bi-directional (L1 and L2 influence each other). The analysis will also reveal whether such influences vary across L2 proficiency groups. This part of the study will contribute to the understanding of L2 acquisition as a dynamic and complex process (e.g., L1 and L2 self-organize their systems).

4. *Intelligibility.* A fourth goal of this study is to verify possible effects of L2 VOT values on the intelligibility of English words (I have not conducted this test yet). monolingual English listeners will be asked to identify words produced by L2 learners, who differ in proficiency. These identifications (% correct) will be used to analyze how intelligible the learners are to the monolingual listeners. The analysis of these data will show whether monolingual speakers of English misunderstand the target words across levels of proficiency. This part of the study focus on the effects of VOT values in the

intelligibility of L2 pronunciation. These analyzes will answer whether levels of proficiency affect monolingual English speakers' identification of words (e.g., native speakers may find words produced by lower-proficiency group more difficult to identify). This analysis will also gives us a perspective of L2 VOT values in terms of native-like intelligibility. Discussions on the importance of adjusting L2 accent in terms of intelligibility will be addressed. This part of the study will, therefore, provide important information in order to gain a comprehensive understanding of the acquisition of L2 VOT categories.

The research questions are:

Research Question n. 1: Will higher-proficiency L2 learners (as identified by general grammatical proficiency measures) produce VOT values in the appropriate phonetic categories closer to what would be expected from English native speakers?

Hypothesis: It is hypothesized that higher-proficiency L2 learners (more than lower-proficiency L2 learners) will demonstrate to produce L2 VOT values in voiced and voiceless stops that are more similar to what would be expected from native English speakers. This result will demonstrate improvement in production of VOT categories, showing that L2 VOT categories can be acquired, even in conditions of formal foreign language instructions and with limited exposure to L2.

Research Question n. 2: Will higher-proficiency L2 learners demonstrate the development of language-specific perceptual systems for VOT categories when processing sounds in their L1 or in their L2?

Hypothesis: L2 learners will be exposed to the same stimuli in two separate language sessions: In the English mode, L2 learners will be asked to identify perceptual boundaries between voiced and voiceless English stops as they are induced to think they are listening to English sounds. In the Portuguese mode, hearing the same stimuli, the same participants will be asked to identify perceptual boundary between voiced and voiceless Portuguese stops as they are induced to think they are hearing Portuguese sounds. It is hypothesized that, for higher-proficiency L2 learners (more than for lower-proficiency learners), the perceptual boundary between voiced and voiceless English sounds will be more similar to what is expected from native English speakers. It is also hypothesized that only higher-proficiency learners will demonstrate to have developed language-specific perceptual systems for English VOT categories (e.g., their perceptual boundary between voiced and voiceless stops in English and in Portuguese differ). This hypothesis is based on previous research, which has found language-specific perceptual systems for highly fluent bilinguals. Lower-level proficiency learners are not expected to show any significant shift in perception across language contexts, but rather, their results are expected to overlap the ones produced by monolingual Portuguese speakers.

Research Question n. 3: Will phonetic drift in L1 VOT values be observed in perception and production of L2 learners?

Hypothesis: Based on previous studies, it is hypothesized that the influences of L1 and L2 will be bi-directional. There are two possibilities though: either phonetic drift will occur only with the higher-proficiency group, or it will occur with all L2 learners,

independently of their level of proficiency. Since previous studies have shown mixed results, it is uncertain which way the outcome will go.

Research Question n. 4: How intelligible will be L2 words with initials /p/ and /b/, produced by L2 learner across different levels of proficiency, judged by native speakers?

Hypothesis: It is hypothesized that intelligibility will be affected by variations on L2 VOT values. However, it is expected that, as learners become more proficient and progress in their learning, monolingual English speakers will have less difficulty in identifying the L2 words.

The answers coming from these four research questions will give a comprehensive understanding of L2 acquisition of VOT categories by late L2 learners who have learned English in formal settings. Next section, a general review of some important studies in each area of investigation is provided (the learning of L2 VOT, development of language-specific perceptual systems for VOT, influences of L2 in the L1 VOT values, and intelligibility of L2 stops by native speakers). Discussions on the importance of this study to the area of L2 acquisition are addressed.

CHAPTER 2 - LITERATURE REVIEW

2.1. Introduction

This chapter reviews a number of significant studies in the acquisition of new VOT categories in second languages. It also discusses how the present study may contribute to this area of investigation.

2.2. L2 Learning of VOT Production

A substantial number of studies have investigated the production of VOT among early and late bilinguals, and have shown that learners improve their VOT production with general improvement in language proficiency (e.g., Flege, 1987; Zampini, 1998). However, there are still some questions to be answered. For instance, do late L2 learners, who have learned the target language in a foreign country, with limited exposure to L1, improve in production of VOT in L2 as they improve in language proficiency?

Some studies on the production of VOT categories in L2 have shown that L2 learners may produce L2 VOT values that are intermediate between their first language and the target language (e.g., Flege, 1987; Fowler, Sramko, Ostry, Rowland, & Halle, 2008). Other studies have shown some evidence that bilinguals are able to produce L2 stops in a native-like fashion (e.g., Caramazza, Yeni, Zurif, & Carbone, 1973; Flege, 1991).

Flege (1987) investigated the production of L2 /t/ by English and French adults and showed that, even highly proficient L2 learners, did not produce a native-like French /t/, in terms of VOT values. The least experienced English speakers of French (American students of French) produced French /t/ with a significantly longer VOT value (English-

like VOT). Although the most experienced group approximated French /t/ to the target sound, it was still significantly different from monolingual French speakers. On the other hand, native French speakers of English (living in Chicago) produced significantly shorter VOT values than monolingual English speakers. Flege argues that equivalence classification, "a basic cognitive mechanism which permits humans to perceive constant categories in the face of the inherent sensory variability found in the many physical exemplars which may instantiate a category" (p. 49), shapes L2 production, preventing learners from form new phonetic categories for similar sounds.

Even simultaneous bilinguals (speakers who learned both languages from birth) have demonstrated to produce stops whose VOT values were rather different from monolinguals. Fowler, Sramko, Ostry, Rowland, and Halle (2008) investigated simultaneous bilinguals in English and French, who lived in Montreal. Their French VOTs were significantly longer than those of the monolingual French speakers, and their English VOTs were shorter than those of the monolingual English speakers. This study suggests that simultaneous bilinguals may also adopt intermediate values between both languages.

Nevertheless, there has been some evidence that L2 learners could attain VOT values that are similar to those produced by native speakers. Native Spanish speakers who learned English early in life (at ages of 5-6) have demonstrated ability to produce VOT values for English/t/ that did not differ from monolingual English speakers (Flege, 1991). However, in the same study, late learners of English (those who had learned English as adults) produced English /t/ with intermediate VOT values. This study shows

that adults L2 learners are more likely to produce intermediate VOT values than early L2 learners.

Caramazza et al. (1973) investigated perception and production of French-English bilinguals (French-Canadian who acquired English by age 7) and monolingual French and English speakers from Canada. In the perception test, participants were asked to label CV syllables produced in synthesized VOT continua (same stimuli for both languages). The production test consisted of reading a set of English and French words. Participants produced different VOTs for English and for French: While bilinguals produced French stops in a native-like fashion, the English stops were significantly different from monolinguals (e.g., their English /t/ [48ms] had an intermediate VOT value). In the perception test, bilinguals show intermediate results between monolingual English speakers and monolingual French speakers. There was, therefore, some asymmetry between perception and production of L2 stops: "language switching is easier for production than perception" (p. 427), at least, for these participants.

Moreover, certain L2 stops might be acquired first than others. Zampini (1998) investigated the learning of L2 Spanish VOT values among native English speakers who were college students enrolled in a Spanish phonetics course. They participated in three sessions in a semester. The production portion of the study consisted of repetition of English and Spanish sentences. Participants were asked to choose between /p/ or /b/. L2 learners were rather successful in producing Spanish /p/, with VOT values that were significantly shorter than their VOT values for English /p/. However, they were unsuccessful in producing prevoiced Spanish /b/ (there were overall positive VOT means for Spanish /b/). Zampini suggests that the prevoicing feature might take longer to learn

than the short VOTs for L2 learners (the short-lag category already exists in English, whereas prevoicing is new category). This longitudinal study shows that different stops may present different levels of difficulties for L2 learners.

In sum, while certain studies have shown that L2 learners produce intermediate VOT values (e.g., Flege, 1987), other studies have demonstrated that L2 learners are able to produce VOT values in a native-like fashion (e.g., Flege, 1991). In addition, certain stops might be easier to acquire than others (e.g., Zampini, 1998), whereas the production of VOT categories might be easier than their perception (e.g., Caramazza, 1973). Through the analyzis of production of English initial stops by L2 Brazilian Portuguese learners of English, this study will answer important questions, such as whether general improvement in L2 would entail improvement in production and perception of the stops, and whether improvement in L2 VOT is a result of new production category. The next section reviews a number of studies on language-specific perception strategies, and addresses how the present study may contribute to this area of inquiry.

2.3. Language-Specific Perceptual Strategies

An important question is whether improvement in perception of English VOT categories comes from L2 learners having formed language-specific perceptual systems or strategies. There is evidence that early, fluent bilinguals develop language-specific perceptual systems (e.g., García-Sierra et al, 2012; Gonzales & Lotto, 2013). In these studies, bilinguals participate in a double phonemic boundary test, in which they are exposed to phonetic dimensions of VOT values in language specific modes (i.e., whether learners are processing sounds in their L1 or their L2). According to Grosjean (2001),

"language mode is the state of activation of the bilingual's languages and language processing mechanisms at a given point in time" (p. 3). In order to promote the activation of language processing mechanisms in either L2 or L1, language context is carefully controlled (e.g., if the goal of the experiment is to induce participants to think they are hearing L2 sounds, the experiment could be conducted in L2 by a native speaker of that language and participants could be explicitly told they would hear L2 sounds). Researchers interested in language-specific perceptual systems expose L2 learners to the same stimuli in two separate sessions (L2 and L1 modes) and verify whether L2 learners shift their phonetic boundaries as a function of language mode only.

Although a number of studies on early, high fluency bilinguals shows that L2 learners demonstrate to possess language-specific perceptual systems (e.g., they shift their phonetic boundaries because they believe they are hearing either L2 or L1 sounds when, in fact, they are hearing the same stimuli in the two language modes) (e.g., García-Sierra et al., 2012; Gonzales & Lotto, 2013; Zampini, 1998), it is unknown whether similar shifts would occur with late L2 learners, who have acquired an L2 in a foreign country. The present study will address this question. If later learners, who had learned L2 in a formal setting (e.g., language schools in a foreign country), demonstrate shifting phonetic boundaries when processing sounds in L2 and L1 modes, this study will show that the acquisition of language-specific perceptual systems is also possible for this population, despite the obvious challenges (e.g., limited exposure to L2).

Gonzales and Lotto (2013) investigated language-specific phonetic systems in English-Spanish bilinguals in a controlled language context. The stimuli were presented to the participants in a continuum of 14 VOT variations from *bafri* to *pafri* (nonsense

words in both languages) for both English and Spanish conditions. The English and Spanish stimuli only differed in the /r/ sounds (Spanish flap /r/ and English retroflex /r/). Instructions and interactions with participants were either in English or Spanish, depending on the language mode. Bilinguals were randomly assigned to the two conditions. Participants were asked to choose the word they heard from the two written forms that appeared on the screen: *bafri* and *pafri*. They hypothesized that, if bilinguals had developed language-specific perceptual systems, they would be expected to shift boundaries as a function of language mode for the stops in the ambiguous area (the short-lag stops, which are considered voiced by English speakers and voiceless for Spanish speakers). The results showed that, in fact, bilinguals significantly shifted their perception across-language context when hearing short-lag stops (e.g., higher instances of voiceless identifications in the Spanish context than in English context). Monolingual English speakers, who also participated in the study, did not shift voicing perception as a function of language mode when hearing short-lag stops. Therefore, this study shows that fluent bilinguals have demonstrated to have language-specific perceptual systems, and that language contexts (e.g., Spanish or English modes) and language cues (e.g., Spanish /r/ vs English /r/) are sufficient to activate more abstract levels of perception.

Evidence for language-specific perceptual systems has also been found in mismatch negativity (MMN) experiments. García-Sierra et al. (2012) investigated the effects of language context in early stages in the brain, that is, before conscious perception, using MMN (e.g., MMN responses increase as acoustic memory trace and acoustic deviant differences increase). Spanish-English bilinguals read magazines and interact with researchers in their language of interest. They were exposed to a VOT

continuum ranging from /ga/ to /ka/. Their results showed that bilinguals produced MMN that were different depending on the language context (e.g., identical acoustic-phonetic information would either result in a significant presence of MMN, or absence of MMN, depending on language context). Their study supports the hypothesis that bilinguals possess language-specific perceptual systems, since bilinguals' mental process is sensitive to language context.

In Zampini (1998)'s study, the investigation of L2 perception of Spanish VOT values among native English speakers were conducted. L2 learners heard a continuum from *pada* and *bada* (nonsense words in both Spanish and English), produced in both languages (there were 20 tokens for each language, which varied from 40 ms of prevoicing to 56 ms of voicing lag in 5-ms intervals). L2 learners and the Spanish-English bilinguals (the control group) did not demonstrate a significant difference in the L2 perception test for English boundaries in the first session, but the difference turned out significant in the second and third sessions, showing that L2 learners started by applying their knowledge of English perceptual boundary, and then moving on to a more Spanish-like performance. When comparing results from L2 learners and Spanish-English bilinguals for Spanish boundaries, no significant difference was found in any of the three sessions. In addition, the study did not show a strong correlation between L2 perception and production for Spanish stops (e.g., while many L2 learners demonstrated a varied of responses for the Spanish perceptual boundaries, they produced short VOT values). Zampini suggests that perception and production "may not be mutually dependent processes" (p. 99) since there is some evidence that accurate production precedes

accurate perception for Spanish /p/, whereas for Spanish /b/, there is no clear interaction between perception and production.

There are, however, a small number of studies in which bilinguals failed to demonstrate language-specific perceptual systems (e.g., Caramazza, Yeni, Zurif, & Carbone, 1973; Williams, 1977). In the investigation of perception of French-English bilinguals, Caramazza et al. (1973) showed that participants, who had labeled CV syllables produced in a VOT continuum in both French and English modes, demonstrated intermediate VOT values, which did not differ across language contexts. In another study (Williams, 1977), Spanish-English bilinguals were asked to label and discriminate synthetized English and Spanish /pa/ and /ba/ in either English or Spanish modes. Only 3 out of 8 Spanish-English bilinguals demonstrated perceptual sensitivity to VOT continuum in the ambiguous region, whereas the majority of the participants failed to shift boundaries across language modes.

There are still some studies that show that not only L2 learners, but also monolingual speakers, shift their perceptual phonetic boundaries according to the language mode (e.g., Bohn & Flege, 1993; García-Sierra, Diehl & Champlin, 2009). Bohn and Flege (1993) investigated the effects of language sets for Spanish-English bilinguals and monolinguals. Their results showed that both bilinguals and monolinguals group had some language set effects (e.g., monolingual Spanish speakers identified short-lag English /d/ tokens as voiced in 65% of instances). This study shows that there was a language effect, but this effect was observed in both bilinguals and monolinguals. It is not clear, however, whether bilinguals and monolinguals used similar strategies (e.g., different phonetic criteria). In García-Sierra et al. (2009), Spanish-English bilinguals

heard a continuum ranging from /ga/ to /ka/ (27 VOT steps) in two language sessions (English and Spanish). Both bilinguals and monolinguals shift their phonemic boundaries, but they did not differ significantly across language contexts.

In general, the majority of the studies on language-specific perceptual systems show that bilinguals develop language-specific perceptual systems, which can be activated through language modes only (e.g., García-Sierra et al., 2012; Gonzales & Lotto, 2013; Zampini, 1998). These studies show that bilinguals are highly sensitive to language context, which enables them to perceive fine-grained differences between L2 and L1 (differences that are there acoustically). For instance, a cross-sectional study on Spanish-English bilinguals demonstrated that bilinguals were able to identify L2 and L1 /p/ and /b/ in a continuum as a function of language mode (Gonzales & Lotto, 2013); a longitudinal study on Spanish-English bilinguals (one semester) showed that they were able to perceive L2 English stops in the second and third sessions, but, then, reverting to a more Spanish-like performance (Zampini, 1998).

The present study focuses on late L2 learners who had learned English as a foreign language in formal settings. It aims to investigate whether L2 perception of VOT values shifts across levels of proficiency (e.g., lower and higher-proficiency learners) as a function of language mode. This study, therefore, has a major contribution to the field.

2.4. Phonetic Drift

Although much of the L2 research focuses on the influence of L1 on L2, a number of studies have shown cross-language phonetic influences (e.g., Chang, 2011; Flege; 1987; Lev-Ari & Peperkamp, 2013; Lord, 2008; Major, 1992; Sancier & Fowler, 1996).

These studies suggest that "L1 system does not become static and invariable, but instead remains dynamic and ever-changing" (Chang, 2011, p. 250). This phonetic drift (or attrition) in VOT values has been most observed in late bilinguals (e.g., Lev-Ari & Peperkamp, 2013; Lord, 2008; Major, 1992), and more recently, among early bilinguals (e.g., Chang, 2011). A great number of such studies have focus on L2 learners who were living in the target-language speaking country (e.g., Chang [2011] investigated Americans learning Korean in Korea; Lev-Ari and Peperkamp [2013] investigated Americans learning French in France; Major [1992] investigated Americans learners of Portuguese who had immigrated to Brazil). Other studies on phonetic drift have focused on L2 learners who were highly proficient (e.g., Flege [1987] investigated French professors in an American university; Lord [2008] investigated Spanish Professors and graduate students of Spanish in the U.S.A.). The present study, on the other hand, will investigate phonetic drift in VOT categories among late L2 learners who have acquired the language in formal settings in a foreign country. Comparisons between perception and production of L1 Portuguese by L2 learners and by monolingual Brazilian Portuguese will be conducted in order to verify whether phonetic drift in L1 Portuguese VOT is observed across learner groups.

Research has shown that L2 learning may influence learners' first language in perception and production of VOT. According to Pavlenko (2000), research has suggested that "the human perceptual system remains somewhat flexible throughout the life course and carries out modifications in response to changes in sensory input" (p. 179). Major (1992), for instance, analyzed the production of English and Portuguese stops in words and in original sentences by five adult Americans who had immigrated to

Brazil. All of them demonstrated to phonetic drift in VOT, showing "loss of native English proficiency" (p. 200).

However, one does not have to immigrate to a foreign country in order for phonetic drift to occur. Lord (2008) investigated the production of English and Spanish words by native English speaker who lived in the U.S.A. with advanced proficiency in Spanish. Although these learners remained in their L1 community, their production of English /k/ was significantly shorter, but not their production of /p t/ (which resembled that of the monolingual English speakers). The L2 learners' production of Spanish /p t k/, on the other hand, had native-like VOT values. This study suggests that English voiceless velar stop could be more subject to be influenced by L2 than the other voiceless stops.

Another interesting study on L2 VOT production (Sancier & Fowler, 1996) investigated the possibility of gestural drift in the speech of a Brazilian Portuguese-English bilingual. The results showed that, after spending some time in the U.S.A., the participant's VOT values in English were significantly longer than after spending some time in Brazil, showing effects of ambient language. The gestural drift was observed both after the experience in the U.S.A. and in Brazil. This study shows that, among other things, more recent experiences (recency effects) have a great impact on production than more distance experiences. More importantly, this study shows that VOT values are not fixed and it changes according to the ambient language.

Not only highly fluent L2 learners, but also novice learners have demonstrated changes in L1 VOT values. Chang (2011) investigate VOT values produced by English speakers enrolled in six-week elementary Korean classes in Korea. Data was collected five times during this period. Chang observed shifts in the VOT values. For instance,

English voiceless stops increased VOT significantly, showing influences of the Korean voiceless stop. These changes occurred twice (between weeks 1 and 2, and weeks 4 and 5). This study demonstrated that phonetic drift in VOT can occur after just some days of L2 exposure. Moreover, Chang's findings have a direct implication on how bilinguals and monolinguals are defined in studies. As Chang argues, problems might arise if L1 speakers who had L2 experience are defined as the monolingual group, and their data used as representative of norms in L1.

In sum, phonetic drift in VOT categories has been observed among L2 learners who were living in the target-language speaking country (e.g., Chang, 2011; Lev-Ari & Peperkamp, 2013), or who were living in a different country (e.g., Lord, 2008). It has also been observed among novice learners, with only some days of exposure (e.g., Chang, 2011), and with fluent L2 learners (e.g., Sancier & Fowler, 1996). The present study will add scientific information to this area of inquiry by investigating whether phonetic drift in L1 VOT manifests across different proficiency groups of L2 learners who had acquired English in a foreign country with limited exposure to L2. This portion of the study will also contribute to the study as a whole since it will add information about the dynamic nature of the relationship between L1 and L2.

2.5. Intelligibility

An intelligibility judgment test informs researchers about aspects of the pronunciation that can affect communication. Munro and Derwing (1995) define intelligibility broadly as "the extent to which a speaker's message is actually understood by a listener" (p. 76). Intelligibility is essential for communication. "If there is no

intelligibility, communication has failed." (Munro, 2011, p. 13). This part of the study will investigate whether English words with initial /p/ and /b/, produced by L2 learners, are intelligible to monolingual English speakers.

Although a number of studies have investigated accentedness in terms of VOT, mainly assessing the degree of perceived foreign accent in stops (e.g., Alba-Salas, 2004; Flege & Fletcher, 1992; Flege, Munro, & MacKay, 1995; Gonzalez-Bueno, 1997; Magen, 1998), few studies have focused on intelligibility. In addition, most of the studies on VOT and intelligibility have been conducted with native speakers or hearing impaired subjects. Krause and Braida (2002), for instance, found out that normal rates produced by native speakers of English improve intelligibility (as opposite to slow rate, for instance). In a more recent work, these authors (Krause & Braida, 2004) analyzed clear speech produced at a normal rate and showed that there are some phonetic features that improve intelligibility. Among these features, they cite frequency of stop burst release and VOT length of word-initial voiceless stop consonants.

On the other hand, studies involving L2 learners have shown that native speakers can perceive small differences in VOT values, and associate that with degrees of accentedness. However, it is less clear how the production of learners affects their intelligibility when they speak with native speakers of the target language (Burleson, 2007). Therefore, this part of the study will contribute to the understanding of the extent to which VOT values affect intelligibility among native speakers. It will also show the relevance of VOT values for L2 learners in terms of intelligibility.

In conclusion, the present research proposes to contribute to the study of the acquisition of L2 VOT categories by investigating late L2 learners who had learned

English in formal settings, with limited exposure to L2, and focusing in: the acquisition of L2 VOT values in production and perception across levels of proficiency; the development of language-specific perceptual strategies; phonetic drift in VOT values in L1 perception and production; and intelligibility of L2 words with initial stops. The next chapter discusses the general methods (participants and design) of the present study.

CHAPTER 3 – GENERAL METHODS

3.1. Participants

3.1.1. L2 Learners

There were a total of 36 Brazilian Portuguese learners of English (26 female, 10 male), whose age ranged from 18 to 50 years old ($M = 29.55$). All participants had at least a high school degree (7 participants had high school degree; 25 were studying or had finished college; 4 had taken graduate-level courses). All participants were born in the town of Araxá, except two, born in São Paulo and Rio de Janeiro. They were all living in Araxá, except one participant who was living in Governador Valadares (a city located in the same state of Minas Gerais). All participants reported having normal hearing, and normal or corrected vision.

3.1.1.1. L2 learners' Proficiency Levels

All L2 learners answered an English language proficiency test - the St. George International Online English Test, obtained online (see Appendix A). The St. George International Online English Test was chosen because the results obtained in this test could be compared to the Common European Framework of Reference for Languages (CEFR). CEFR was developed to establish international standards for language assessment and teaching in Europe and has been applied in modern languages since the 70's. CEFR divides the levels of proficiency into three levels of users (basic, independent, and proficient) (see Appendix B). This language test, therefore, provides reliable results in terms of the test takers' levels of proficiency.

The online test was revised by the researcher, along with a native English speaker, who was a trained teacher in English as a second language. After their assessment of the test, questions 4, 19 and 29 were slightly modified in order to avoid either ambiguity or bias toward British or American dialects (e.g., in question 19, *needn't* and *needn't have* were changed to *don't need to* and *didn't need to*). In order to estimate the test difficulty and the time L2 learners would require to complete it, a few Brazilian Portuguese learners of English, who were living in Brazil, took the English language proficiency test. Their impression of the test was that it was relatively balanced between easy and difficult questions. They took around 20 minutes to complete the test.

The mean of the English language proficiency test taken by the L2 learners participating in this study was 26.94, the median was 27.5, and the mode was 31. The standard deviation was 8.82. The lowest score was 10 (25%) and highest score was 40 (100%), yielding a statistical range of 30. Overall, the scores on the test were somehow skewed, with a skewness of -0.19. The Kurtosis shows that the distribution of scores was in some way flat, with a value of -1.241 (see Appendix C for the summary of results). The graphical display of the scores is presented in Figure 1.

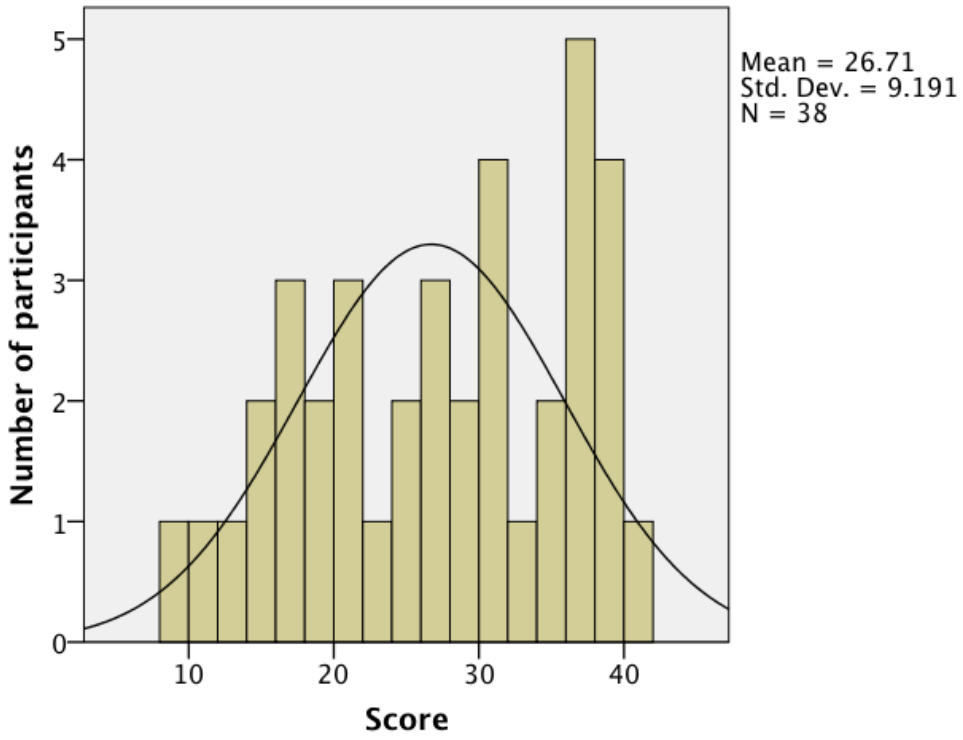

Figure 1. Distribution of scores obtained by Brazilian Portuguese learners of English in the English language proficiency test (maximum possible score: 40).

A decision was made in order to have the participants in two groups of proficiency with equal number (lower and higher). The cut-off value was 27, which roughly corresponds to the cut-off between intermediate and upper intermediate, according to the distributions of levels from the Council of Europe's Common European Framework (their cut-off is 29). Therefore, 18 L2 learners were placed in the lower-proficiency group (L) and 18 were placed in the higher-proficiency group (H) (see Appendix D for individual scores and their correspondent group of proficiency).

3.1.1.2. L2 Language Background Questionnaire

L2 learners answered a language background questionnaire (see Appendix F). This questionnaire was given in Portuguese in order to guarantee that all participants (including beginners) could provide their information accurately. Information from their language background questionnaire is summarized in Table 2. Characteristics of the lower (L) and higher-proficiency (H) groups, reported on the language background questionnaire, are analyzed and reported below.

Table 2.

Background information (Ms, SDs, ranges) of the Brazilian Portuguese learners of English, according to their level of proficiency.

	Gender	*Age*	*Acq*	*% use English*	*Length of learning*	*Contact with NS*	*LEC*
Lower-proficiency group	13 (f) 5 (m)	29.11 (9.08) 19-47	21.06 (9.38) 9-44	31.74 (15.4) 14.28-51.32	3.02 (1.66) 0.41-7	15 (never) 3 (yes)	18 (never)
Higher-proficiency group	13 (f) 5 (m)	30.56 (9.53) 18-50	11.39 (2.85) 6-17	47.37 (15.5) 11.42-70	9.94 (7.27) 2-21	10 (never) 8 (yes)	14 (never) 4 (yes – from 6 month to 3 years)

Note: Age (in years); Acq (age of acquisition); Length of learning (in years); Contact with NS (whether participants have had contacted with native speakers of English); LEC (whether participants have lived in an English-speaking country).

Age and Gender

Both L2 learner groups had the same number of male and female participants (13 female and 5 male in the L and in the H groups). In order to investigate if there was a difference in age mean between L and H groups, an independent *t*-test was conducted. It

showed that there was no significant difference in age for the lower group (M = 29.11, SD = 9.08) and the higher group (M = 30.56, SD = 9.53) conditions; $t(34) = .465$, $p > .05$. This result suggests that their improvement in English is not related to their current age.

Age of Acquisition

Various studies indicate that the age of first exposure to L2 influences the overall success of the acquisition of a second language in naturalistic settings (e.g., Flege, Schirru, & Mackay, 2003). However, in a foreign language context, age of first exposure might not be as relevant as one might think. Muñoz (2010) argues that, when researching L2 language acquisition as a foreign language, it is important to distinguish between age of first exposure and age of acquisition. For her, age of first exposure to a foreign language might represent "only insignificant exposure" (p. 44), whereas age of acquisition is related to the beginning of significant exposure to L2. In this study, Brazilian Portuguese learners of English were first exposed to English either in a private English school, or as part of their regular curriculum at school. Participants were asked to report the age they felt was more significant for them in terms of learning. Following Muñoz, the age considered here is the age L2 learners judged to be the age of acquisition (meaningful exposure to L2), which is then considered the starting point of their L2 acquisition.

In order to verify if age of acquisition of English had any effect on their current proficiency, an independent t-test was conducted. There was a significant difference of age of acquisition for the lower-proficiency group (M = 21.06, SD = 9.38) and the higher-proficiency group (M = 11.39, SD = 2.852) conditions; $t(20.11) = 4.182$, $p < .001$ (since

Levene's test of equality of variances revealed that the homogeneity of variance was not assumed, values from Equal Variances not Assumed are reported) . Although there were overlaps between the L or the H groups, the L group had much more variation, and a fair number of learners who reported their age of acquisition as being 18 or over (12 learners out of 18) (see Appendix K for the distribution of age of acquisition by levels of proficiency). All L2 learners from the H group, on the other hand, reported their age of acquisition as being under 18 years old. Therefore, the H group started learning English significantly earlier in life than the L group.

Knowledge of Another Foreign Language, Experience Abroad, and Contact with NS

From the 36 participants, 12 (33.33%) reported having some knowledge of French, Spanish or Italian, besides English (8 in the H group and 4 in the L group). They had studied these languages in Brazil from 1 month to 5 years. The majority of them, 24 (66.66%), have never studied another foreign language besides English. None of them reported being fluent in another language, besides English and Portuguese.

Only four L2 learners (all in the H group) had the opportunity to stay in an English-speaking country for a longer time: 4 L2 learners stayed in the U.S.A. for 6 months, 9 months, 1 year and 3 years respectively. Five L2 learners had visited some English-speaking country for a few days. The majority (27 learners out of 36) had never visited another country, including all L2 learners in the L group.

Their contact with native speakers was rather limited. A large number of L2 learners (25 out of 36) had never had contacted with native speakers of English. The ones that had had some contacted with native speakers were 4 learners who had lived abroad

(all from the H group), 5 who reported had had a native speaker as a teacher or as a colleague at school (3 from the H group and 2 from the L group), and two who said they had contacted with native speakers online (one from the L group and another from the H group).

Length of Learning

Along with age of acquisition, it is important to investigate how long L2 learners have studied English. As expected, an independent *t*-test revealed that there was a significant difference between length of learning (in years) for the lower-proficiency group ($M = 3.02$, $SD = 1.66$) and the higher-proficiency group ($M = 9.94$, $SD = 7.27$) conditions; $t(18.77) = 3.93$, $p < .05$ (since Levene's test of equality of variances revealed that the homogeneity of variance was not assumed, values from Equal Variances not Assumed are reported). L2 learners who had studied English for a longer time are more advanced in their L2 acquisition.

In sum, the L2 language background questionnaire reveals that L2 learners hadn't had much opportunity to interact with native speakers of English; the H group differs significantly from the L group in age of acquisition (the H group started earlier), but not in terms of current age; and that the H group had studied English longer than the L group. Below, the remaining information provided in the questionnaire is analyzed: the L2 learners' self-report of their perception of English skills, of their use of English, and of their motivation.

Self-Perception of L2 Use

Studies have reported that L2 use correlates with levels of proficiency (e.g., Gatbonton & Trofimovich, 2008). Participants were asked to estimate in percentage how much English they currently used in certain situations and places (at the language school, at home [e.g., homework], on the Internet, at work, watching movies/videos, with friends, and with online classes).

In order to verify whether learners' differences in proficiency (L and H groups) correlate with differences in L2 use of English, an independent *t*-test was conducted. The mean comparison shows that there was a significant difference in the use of L2 English for the lower-proficiency group ($M = 31.74$, $SD = 11.69$) and the higher-proficiency group ($M = 47.37$, $SD = 14.68$) conditions; $t(34) = 3.53$, $p < .05$ (see Appendix L for the distribution of use of English by levels of proficiency). The H group use L2 English more often than the L group.

Self-Perception of English Skills

Participants were asked to estimate their English abilities (speaking, writing, listening, grammar, vocabulary, pronunciation, reading) by choosing a number from 1 (very low) to 7 (excellent). The summary of their responses (*Ms and SD*) is shown in Appendix M. A series of independent sample *t*-tests was conducted for each of the self-reported English skills in order to verify if there was any difference in means between the L and the H groups.

The result shows that there was no significant difference in the self-reported L2 English skills for the L and H groups in any of the English skills ($p < .05$). This result

shows that both L and H groups are homogenous in terms of self-perception of their L2 English skills. Since in this study, L2 learners' self-assessment of L2 language skills will not be accounted as a variable affecting L2 proficiency groups, no further discussion on the topic will be addressed.

Self-Perception of Motivation

Although a foreign language teacher and an L2 learner would agree that motivation has a key role to achieve success in another language, it is not clear what effects motivation has in pronunciation. Some studies have reported that motivation exerts some influence in L2 learners' pronunciation. Elliott (1995), for instance, found out that the success in having a native-like pronunciation was primarily related to learners' motivation and desire to have an accurate pronunciation. The relative importance of motivation on the degree of foreign accent, however, is rather uncertain, mainly because studies have not quantified motivation precisely, and because of the possibility of confounding (Piske, MacKay, & Flege, 2001). Nevertheless, motivation has seen as "one of the main determinants of second/foreign language learning achievement" (Dörnyei, 1994, p. 273).

In this study, L2 self-perception of motivation is assessed by asking participants to respond to seven statements related to motivation in a Likert-scale choosing from 1 (strongly disagree) to 7 (strongly agree) (see Appendix N for the summary of responses). Possible differences on self-perception of motivation between the L and H groups were analyzed through a series of independent *t*-tests. From the seven statements, only statement n. 6 (*When I speak English, I try my best to not use Portuguese*.) had a

significant result, showing that there was a difference between the lower (M = 5.28, SD = 1.22) and higher-proficiency groups (M = 6.33, SD = 1.18) conditions; $t(34) = 2.62$, $p < .05$. As expected, the H group avoids Portuguese when speaking English more often than the L group (see Appendix O for the distribution of responses).

In conclusion, the L2 language background questionnaire shows that the H group differs significantly from the L group in the following ways: they started learning English earlier; they studied English for a longer time; they have used English more frequently; and they have tried to avoid Portuguese when speaking English more often.

3.1.2. Monolingual Brazilian Portuguese Speakers

There were a total of 36 monolingual Brazilian Portuguese speakers (26 female and 10 male). On average, monolingual Brazilian Portuguese speakers were an older group (M = 33.08); their ages ranged from 18 to 65. They were all born in the state of Minas Gerais (21 participants were born in the town of Araxá and 15 were born in different locations). They all were living in Araxá when the data collection was conducted. Most of them were studying in a college or had already graduated (15 participants); others were taking graduate-level courses (13 participants), and some had a high school degree (8 participants). All participants reported having normal hearing, and normal or corrected vision.

A small number of monolingual Brazilian Portuguese speakers had had some English classes (4 participants). Following Chang (2011), care was taken in defining L1 speakers as the monolingual group for Portuguese VOT analysis. In order to be sure that these few participants were, in fact, monolinguals, the researcher asked them to produce

any English sentence, which they were unable to do. Therefore, they were included in the monolingual group.

3.2. Design

L2 learners participated in two language sessions: English and Portuguese. Each language session consisted of two consecutive experiments: a production test, followed by a perception test (these tests were conducted in Brazil this past July). After finishing the English session, the Portuguese session was conducted (either on the same day, or on a future day, depending on the participants' availability). The English and Portuguese sessions were mirror images of each other, that is, both Portuguese and the English production and perception experiments were designed and conducted in a similar manner, except that one session was in English and the other in Portuguese. In general, the English session lasted around 35 minutes, and the Portuguese session lasted around 25 minutes. When L2 learners finished both language sessions, they were instructed to answer the English language proficiency test (see Appendix A), the language background questionnaire (see Appendix F), and sign the consent form (Appendix G). Each participant took around one hour to one hour and twenty minutes to complete all the tasks. At the end of the data collection, each participant received a small notebook as a gesture of gratitude.

A native English speaker (born and raised in New York City), who had been trained by the researcher, conducted the English session. The researcher (a native Brazilian Portuguese speaker, born and raised in Araxá, where the data collection took place) conducted the Portuguese session. Since English language context is much harder

to elicit in a non-English speaking country, all the sessions started with the English portion first. Participants had their first contact only with the English native speaker, while the Portuguese speaker waited in a different room. When the English session was over, the English speaker would call the researcher to conduct the Portuguese session, and stayed in a different room.

As an additional attempt to control the language context and environment, all L2 data were collected in two English schools (e.g., salient objects in the environment may effect participants' production [e.g., Hay & Drager, 2010]). Eliciting Portuguese language mode was, obviously, not difficult since learners could immediately feel comfortable when talking to the researcher, who shared not only their native language, but also the regional dialect. Nevertheless, the researcher always initiated the Portuguese session by having a short dialogue in Portuguese with the participants in order to guarantee that the Portuguese mode was well-established.

The data from the monolingual Brazilian Portuguese speakers were collected in quiet room in a local college, where some of its students, professors, and employees participated. Some other monolingual speakers from the community also participated; their data were collected in a quiet room at the home of researcher's family.

Monolingual Brazilian Portuguese speakers participated only in the Portuguese session. After finishing the production and perception experiments, they were asked to answer a background questionnaire (see Appendix H) and sign the consent form (see Appendix G). Each of the participants received a small notebook as a gesture of gratitude.

The decision about the order of the experiments (the production task first, followed by the perception test) was taken based on the level of difficulty reported by the

first L2 Brazilian Portuguese speaker who participated in the study. He had done the perception test first, and he reported he felt the perception test was much more difficult than the production task. In addition, having the participants taking the production task first would strengthen the language context, helping learners to be more attuned to English, and more prepared for the perception test. Finally, since the production task was perceived as an easier task, taking it first, could help learners feel more relax with the entire process.

CHAPTER 4 – PRODUCTION DATA

4.1. Introduction

This study analyzes production of VOT in ms word-initially by Brazilian Portuguese learners of English and monolingual Brazilian Portuguese speakers in a delayed repetition task. Comparisons among different levels of proficiency and between L2 learners and monolingual groups will be made. This information will reveal whether L2 learners improve their production of L2 VOT values as they progress in their learning, and whether their production of VOT values in Portuguese display phonetic drift. This chapter describes the production study (a delayed repetition task) and how the data was collected, and how the data will be analyzed.

4.2. Participants

They are the same participants reported in General Methods (Chapter 3).

4.3. Material

The material for the delayed repetition task was English and Portuguese words with initial /p b k g/ produced in two different phonological environments: followed either by a low vowel or by a high vowel. There were 10 words for each phonological environment (10 words x 4 target phonemes x 2 phonological environment = 80 words for each condition). All the words were minimal pairs (e.g., *peach/beach*) or near minimal pairs (e.g., *cool/goose*) since it was impossible to find the same number of perfect minimal pairs in both languages. Table 1 shows the complete list of English and Portuguese words used in the production test. An attempt was made in order to use more

frequent words, but the researcher had to add some words that were rather uncommon in both languages in order to have the same number of words in each environment. This, however, is not expected to be a problem for L2 learners since, along with the auditory stimuli, participants were also exposed to the correspondent orthographic form of the words and conceptually related pictures in order to facilitate the task.

Table 1.
English and Portuguese words used as stimuli in the delayed repetition task.

ENGLISH				
	/p/	**/b/**	**/k/**	**/g/**
Stops + /ɑ/, /æ/	pond	bond	cop	goth
	pack	back	car	garb
	par	bar	cot	got
	part	barb	cod	god
	pan	ban	card	guard
	pat	bat	cap	gap
	park	bark	cat	gas
	pox	box	carry	Gary
	pot	bot	cash	gash
	path	bath	cab	gab
Stops + /ɪ/, /i/, /ʊ/, /u/	pea	bee	could	good
	pin	bin	kill	gill
	peep	beep	kilt	guilt
	peach	beach	kick	gig
	pig	big	curl	girl
	pit	bit	kit	git
	pull	bull	kiss	gift
	Pete	beat	cool	goose
	put	book	keys	geese
	push	bush	coo	goo
PORTUGUESE				
	/p/	**/b/**	**/k/**	**/g/**
Stops + /a/	panda	banda	calo	galo
	pata	bata	cato	gato
	pato	bato	cala	gala
	pano	banho	cama	gama
	paca	baga	cata	gata
	pala	bala	cana	gana
	palha	ballha	canso	ganso
	pasta	basta	castro	gastro
	Papa	baba	case	gaze
	passo	baço	cabo	gabo
Stops + /i/, /u/	pia	Bia	quinto	guincho
	pica	bica	quilha	guilha
	picho	bicho	quina	guina
	pilha	bilha	quica	guiga
	pinga	binga	quincha	guincha
	pico	bico	quita	guita
	pingo	bingo	Quito	Guido
	pulo	burro	cuspa	gume
	puxa	bucha	cudo	Guto
	puxo	bucho	cura	gula

The material for the production data, both in Portuguese and English, were recorded on separate days in a sound-proof booth at the Spanish Phonetics Lab at the University of Arizona, using the following equipment: Fostex DC-R302 3-Channel Audio Mixer and Stereo Recorder and Shure SM10A Headworn Microphone.

The English and Portuguese words were recorded by two male native speakers (one of each language). The English and Brazilian Portuguese speakers received the same instructions in their respective languages: They were asked to read the instructions for the experiment, followed by a list of words in the carrier phrase _____ *is the word* (_____ *é a palavra.*), as natural as they could. They were also asked to produce the question *What is the word?* (*Qual é a palavra?*), which was later added at the end of each carrier phrase. This carrier phrase was chosen because the researcher was interested in a sentence that would be as simple as possible; therefore, not adding another layer of difficulty for L2 learners. The English and Portuguese native speakers were asked to read the material three times. The recording considered the best by the researcher (e.g., clearer) was then used as stimuli.

4.4. Stimuli

4.4.1. English Stimuli

All the English words were monosyllabic and they followed the American English accent. The words were chosen in consulting with an American English speaker, who was also a phonetician. A native speaker of English, who was born in the Tucson area (Arizona), and was a college student at the University of Arizona, provided the English stimuli. He was 22 years old and had had some French classes in the past. He,

however, reported that he could not speak French since these classes had been taken some time in the past. Care was taken in order to choose a native speaker who had no knowledge of Portuguese or Spanish, and who could not speak another foreign language. Sound files were then normalized for pitch intensity at 75db using Praat script.

4.4.2. Portuguese Stimuli

All Portuguese words were disyllable and had stress on the first syllable. They were also minimal pairs (e.g., *pica/bica*) or near minimal pairs (e.g., *cura/gula*). For the selection of the words, the researcher consulted the Dicionário Michaelis de Português UOL (2009) available online.

A native Brazilian Portuguese speaker, who was born in São Paulo City, provided the Portuguese stimuli. He was a male college student at the University of Arizona, who came to the U.S.A. through a Brazilian program called Science Without Borders. He was 23 years old and had lived in the U.S.A. for 8 months at the time of the recordings. He self-reported as being in an intermediate learner of English. Care was taken in order to choose a native Brazilian Portuguese speaker who had lived in the U.S.A for a short period of time and whose contacts with Portuguese language were strong (the speaker reported that he frequently used Portuguese with his Brazilian friends in town). In addition, the speaker was from the Southeast of Brazil, the same region where the data would be collected; controlling, therefore, for accent variations. Sound files were then normalized for pitch intensity at 75db using Praat script.

4.4.3. Pictures as stimuli

Along with the auditory stimuli, participants saw the orthographic form of the word on the screen, and a picture, which semantically represented the word in some way (see Appendix E for some examples). The goal was to assure that all learners, independently of their level of proficiency, would have been able to repeat the words (e.g., beginners might have encountered unfamiliar words). Since participants might have known or not known the words they were repeating, the delayed repetition task could potentially increase learning as a function of trials. Therefore, adding pictures would turn the task more meaningful to them; it would also increase learners' motivation, helping them be more alert and engaged in the task, which, ultimately, contributes to better results.

All the pictures used in the delayed repetition task were creative commons or were in public domain. The pictures were extracted from Clkert, Hatasa (2003), Images Public Domain Clip Art, Sherman (n.d.), Snodgrass and Vanderwart (1980), and Szekely, Jacobsen, D'Amico, Devescovi, Andonova, and Herron (2004). Care was taken in order to choose pictures that were black and white, were simple and basic (e.g., outline drawings), and were as unambiguous as possible. They all have approximately the same size and occupied the central location on the screen. This way, the pictures would not be a distraction from the main goal of the experiment.

4.5. Procedures for the Delayed Repetition Task

Delayed repetition tasks have been used in L2 studies as a way to elicit L2 stops (e.g., Aliaga-García & Mora, 2009; Flege & Edfting, 1987). In this study, the delayed

repetition task, both in English and Portuguese, was done through the PsychoPy Software (Peirce, 2014) and conducted using the researchers' personal computer (MacBook Air, 2011). Participants' production was recorded using Fostex DC-R302 3-Channel Audio Mixer and Stereo Recorder and Shure SM10A Headworn Microphone. The sound was adjusted for the participants' comfort.

First, the researcher (or the native English speaker who assisted her) explained the experiment to the participants in the respective language mode and verified whether they understood the task. When participants felt they were ready, the experiment began. Participants heard (and read on screen) the instructions (either in English or in Portuguese):

You will hear some English sentences.

Repeat the first sentence, according to the example. Example:

Speaker: "TABLE is the word. What is the word?"

You: "TABLE is the word."

Click SPACE to start.

After pressing the *spacebar*, participants saw a fixation cross of 0.5 seconds, followed by 3 initial practice trials (no words with stop-initials were included in the practice trials). After another fixation cross of 0.5 seconds, a block of 80 randomly ordered trials were presented, followed by a final fixation cross and a thank-you message. After pressing the *spacebar*, participants did not have to touch the computer again, just concentrate on the repetition. The sentences presented to the participants were presented only one time.

Both English and Portuguese experiments had the same procedures and duration, except that the time set up for the participants to repeat the Portuguese sentences was a little bit shorter than the time set up for the English sentences (0.6 and 0.7 seconds respectively). This decision was taken since having the time reduced a little bit would avoid boredom.

In the following sections, I describe how the production data will be analyzed.

4.6. VOT Measurements of L2 English Production Data

The data produced by L2 learners in the delayed repetition task will answer whether general improvement in L2 language entails improvement in production of VOT categories of Brazilian Portuguese learners of English (Research Question n. 1). Improvement in L2 VOT means a lengthening of lag VOT (a lengthening of aspiration) in the voiceless category and possibly a reduction of prevoicing in the voiced categories. It is hypothesized that higher-proficiency L2 learners will demonstrate improvement in the production of VOT categories, showing that L2 VOT categories can be acquired, even in conditions of formal foreign language instructions and limited exposure to L2.

The data from L2 learners in the delayed repetition task yielded a total of 2,880 English words (10 words x 4 stops x 2 phonological environment x 36 participants). In order to verify improvement of VOT categories among L2 learners, their production data of L2 English will be compared between the L and the H groups.

A 4-way mixed design ANOVA will be conducted with voicing (voiceless, voiced), place of articulation (bilabial, velar), vowel height (low, high), as the within-subject factors, and proficiency (L, H) as the between-subject factor. The dependent

variable is VOT, measured in ms. In addition, appropriate tables of means and standard deviations will be provided. It is expected that voicing and place will affect VOT. If interactions are found, the data will have to be split and checked for new interactions (proficiency will not be split since this is the factor I am interested in).

4.7. VOT Measurements of L2 English and L1 Portuguese Production Data

In order to verify whether differences between the L and H groups (in terms of VOT values) are due to the formation of new VOT categories in production for L2, the L2 learners' production in the two language modes (English and Portuguese) for each learner group will be compared (Research Question n. 1). If L2 learners show that they have lengthen the VOT (a lengthening of aspiration) in the voiceless category and possibly a reduction of prevoicing in the voiced categories for L2 English, and that their Portuguese data show short lag VOT values in the voiceless category and prevoicing in voiced category, then, L2 learners will have shown formation of new VOT categories in production for L2.

The data yielded a total of 2,880 English words (10 words x 4 stops x 2 phonological environment x 36 participants) and 2,880 Portuguese words (10 words x 4 stops x 2 phonological environment x 36 participants). For each L2 learner group separately (L, H), a 4-way repeated-measures ANOVA will be conducted with voice (voiceless, voiced), place of articulation (bilabial, velar), vowel height (low, high), and language modes (English, Portuguese) as the within-subject factors. The dependent variable is VOT, measured in ms.

4.8. VOT Measurements of Portuguese Production Data

The data produced by monolingual Brazilian Portuguese speakers will be used to verify whether phonetic drift has occurred in production of L1 Portuguese by L2 learners of English, and whether phonetic drift differs across levels of proficiency (Research Question n. 3). If the production of Portuguese by L2 learners differs from the production of monolingual Brazilian Portuguese (e.g., the Portuguese voiceless stops produced by L2 learners – but not those produced by monolinguals - have longer lags, going in the direction of English VOT values), then, phonetic drift will have been observed.

The data from monolingual Brazilian Portuguese speakers and from L2 learners in the delayed repetition task yielded a total of 2,880 Portuguese words for each group (10 words x 4 stops x 2 phonological environment x 36 participants). In order to verify whether phonetic drift occurred in the L2 learners' production of Portuguese, a comparison between the production of Portuguese by L2 learners and by the monolingual Brazilian Portuguese speakers will be conducted. For each learner groups separately (L and H), a 4-way mixed-design ANOVA will be conducted with voicing (voiceless, voiced), place of articulation (bilabial, velar), vowel height (low, high), as the within-subject factors, and language groups (L2, monolinguals) as the between-subject factor. The dependent variable is VOT, measured in ms.

CHAPTER 5 – PERCEPTION DATA

5.1. Introduction

Following Gonzales and Lotto (2013), L2 learners took part in a double phonemic boundary test in order to verify whether Brazilian Portuguese learners of English have developed language-specific perceptual systems for VOT categories (Research Question n. 2). In Gonzales and Lotto's study, Spanish-English highly proficient bilinguals were randomly assigned to either Spanish or English conditions. Both groups heard a continuum of 14 VOT variations from *bafri* to *pafri* (non-words in both languages). Language membership was conveyed through instructions in specific language modes, and through the /r/ for each mode (in the Spanish mode, participants heard Spanish /r/ [a flap], and in the English mode, they heard English /r/ [a retroflex]). The experiment consisted of 3 blocks of 14 randomly ordered trials. The result shows that bilinguals shifted their perception across language contexts when hearing short-lag stops as a function of language mode only. Gonzales and Lotto demonstrated that language-specific phonetic systems contribute to cross-language shifting since bilinguals identified the same initial /p/ and /b/ in the pseudo-words as either Spanish or English, depending on the language context.

This study uses the same rational procedures and stimuli used by Gonzales and Lotto (2013), but focuses in a different population: late L2 learners who had acquired English as a second language in formal settings, with limited exposure to L2. Participants took part in two identical perceptual tests (e.g., same stimuli and procedures) in two language modes (English and Portuguese). In each language session, participants were exposed to the same stimuli, but they were induced to think they were hearing either

English sounds (in the English session), or Portuguese sounds (in the Portuguese session). For instance, native speakers of English and Portuguese conducted the sessions in their respective languages, and participants were told explicitly that they would hear words pronounced in the language in focus.

Although the design of the study tries to replicate as closely as possible Gonzales and Lotto (2013), it is not an exact replication. For instance, in their study, there were 3 blocks of 14 randomly ordered trials. In this study, there was only one block of 80 randomly ordered trials. This decision was taken for two reasons:

a. Increasing the number of tokens would increase the reliability of the results (e.g., it would help compensate for possible mistakes produced by participants on the performance of the task, such as pressing a key by mistake).

b. Having only one block would avoid human error in the analysis of the data (in this experiment, participants saw the word *BAFRI* always on the left of the screen and the word *PAFRI,* on the right, for both English and Portuguese sessions, whereas in Gonzales and Lotto (2013), the words were counterbalanced).

Another small change included, for instance, the use of the colors of the American and Brazilian flags in the words BAFRI and PAFRI in order to help increase sensitivity of language mode. The following section describes the stimuli and the experiment in detail.

5.2. Participants

They are the same participants who took part in the production data and whose information has been reported in the General Methods (Chapter 3).

5.3. Stimuli

The English and Portuguese stimuli for the double phonemic boundary test were provided by the researchers Kalim Gonzales and Andrew J. Lotto, and consisted of the same stimuli used by them in their 2013's study. Gonzales and Lotto prepared the stimuli in the following way: A bilingual speaker produced the words *bafri* and *pafri* in both Spanish and English accents. Then, the final /ri/ was resynthesized to control for duration, F0 onset and contour, preserving the salient features of English /r/ and Spanish /r/. Using the English */ba/* and */pa/,* a continuum was created: 14 variants (steps of 5 ms, from -35 to +35 ms, skipping 0 VOT). They were attached to English /ri/ and Spanish /ri/, resulting in 14 variations for each language mode.

Although the stimuli from Gonzales and Lotto (2013) was natural speech produced by a Spanish-English bilingual, the same stimuli was used with Portuguese speakers due to the following reasons:

1. Portuguese and Spanish flaps are similar in a number of ways: Both sounds are described as alveolar flap and they do not occur word-initially (Cotton & Sharp, 1988; Mateus & d'Andrade, 2000). Flaps can occur as part of a two-consonant cluster (after a consonant in onset position) in Spanish and Portuguese, the same context presented in the stimuli (*bafri* and *pafri*). In addition, the words *bafri* and *pafri*, which are non-words in English and Spanish, are also non-words in Portuguese. They are, however, possible words in the three languages.

2. Spanish and Portuguese are phonologically similar. Similar to Spanish, but differently from English, Portuguese speakers prevoice initial /b d g/, and produce initial /p t k/ with short-lag values (e.g., Klein, 1999).

3. The stimuli were presented to a couple of Brazilian Portuguese speakers, including the researcher, who perceptually identified the Portuguese flap in the words *bafri* and *pafri.*

4. Using the stimuli from Gonzales and Lotto with a different population (their participants learned both languages before 8 years of age and were highly-proficient bilinguals, whereas, in this study, the participants were late L2 learners), provides an excellent opportunity to compare results (e.g., whether or not late L2 learners behave differently from highly proficient bilinguals in terms of phonetic systems).

5.4. Procedures for the Double Phonemic Boundary Test

For the double phonemic boundary test, participants used the researcher's computer (MacBook Air, 2011), and AKG K77 Headphones. First, participants were told that they would hear two English words (for the English session). For the Portuguese session, participants were told they would hear the same words they heard in previous experiment but, this time, pronounced in Portuguese. This is a slight modification from Gonzales and Lotto's (2013), who had decided to inform participants that they would hear real words in English and then in Spanish. However, participants in this study understood the task better when the researcher explained that the words would be pronounced in Portuguese (no mention whether the words were real or imaginary).

When participants felt ready, the experiment started. First, the participant heard and read the instructions on the screen (the instruction recordings were done by the same native speakers who provided the stimuli for the production data). The instruction was as follows:

You will hear two words in English: BAFRI and PAFRI.

If the word starts with B, click the left arrow.

If the word starts with P, click the right arrow.

Click SPACE to start.

For the Portuguese session, the instruction was the same, except that it was in Portuguese, and the message said that they would hear Portuguese words. In order to help participants find the right keys on the keyboard, the researcher marked the left arrow with a letter B, the right arrow with a letter P, and the spacebar with the words SPACE/ESPAÇO. As a way to promote language context, the words BAFRI and PAFRI bore the colors of the American and Brazilian flags (for the English session, BAFRI was in red and PAFRI, in blue; for the Portuguese session, BAFRI was in green and PAFRI, in yellow). In addition, the words *English* or *Português* also appeared above the words BAFRI and PAFRI (see Appendices I and J for screen shots of the interface).

After listening to the instructions and clicking SPACE, participants saw a fixation cross, which lasted 0.5 seconds. Then, the sentences were presented to them in a randomized fashion. Participants had 4.10 seconds to answer each time they heard the word, which the researcher considered sufficient time for them to respond. They could also set their own pace (e.g., go faster than 4.10 seconds), but if they waited too long, they would hear the following word. The screen, however, would not change. The task ended with a fixation cross (0.5 seconds), followed by a thank-you message.

A few times, participants interrupted the test to ask a question (e.g., a few participants thought there was a problem with the test because they thought they were

listening to the same word repeated many times). In this case, the researcher would stop the experiment, explain the nature of the test once again, and reinitiate the experiment.

In the following sections, the ways in which perception data will be analyzed are discussed.

5.5. Perceptual Identification of L2 English-Mode VOTs

These data will answer whether L2 learner group (L and H) perceives initial English /b/ and /p/ differently in a continuum by comparing group means. It is hypothesized that there will be a significant difference in mean between L and H groups, demonstrating improvement in perception of VOT categories. More specifically, it is predicted that the H group will categorize more of the stimuli as voiced than the L group, which means that the boundary between /b/ and /p/ for the H group will be moved towards the right with respect to the L group.

The data yielded a total of 5,040 responses for English (14 VOT variations x 10 repetitions x 36 participants). In order to verify differences among L2 learner groups in perception, a 1-factor between ANOVA, with proficiency (L, H) as the between-subject factor will be conducted. The proportion of *pafri* identification will be the dependent variable.

5.6. Perception Identification of L2 English and L1 Portuguese-Mode VOTs

These data will answer whether late L2 learners can establish language-specific perceptual systems as a function of language modes. If previous analysis shows that there is a difference between the L and H groups in terms of perception identification of L2

English, the analysis of L2 learners' perception data of L2 English and L2 Portuguese will demonstrate whether the difference between L and H is due to the development of language-specific perceptual systems for VOT categories. In this case, the H group will show a larger effect of context than the L group when comparing the two language-modes. If these results are confirmed, the study will show that late L2 learners of English, who have learned English as a foreign language, with limited exposure to L2, are able to develop language-specific perceptual systems for VOT categories (the ability to achieve such an abstract level of representation has been attributed only to early highly-proficient bilinguals).

In order to verify whether there is any significant difference between L2 English mode and L1 Portuguese mode, a (2) x 2 mixed-design ANOVA will be conducted, with language mode (English, Portuguese) as the within-subject factor, and proficiency (L, H) as the between-subject factor. The proportion of *pafri* identification will be the dependent variable.

5.7. Perceptual Identification of Portuguese-Mode VOTs

Comparisons between the Portuguese data from L2 learners and from monolingual Brazilian Portuguese will answer whether L2 learners' production of Portuguese VOT had been influenced by L2 English. The data will show whether phonetic drift occurs in perception across levels of proficiency. A 2-factor mixed-design ANOVA will be conducted with vowel height (low, high) as the within-subject factor, and language groups (L, H, monolinguals) as the between-subject factor. The proportion of *pafri* identification will be the dependent variable. The analysis of the Portuguese

perception of /p/ and /b/ in a continuum by L2 learners of English and monolinguals will reveal whether L1 Portuguese can be affected by L2, even in a foreign language context.

The next chapter addresses intelligibility, how the data will be collected and analyzed.

CHAPTER 6 – INTELLIGIBILITY

6.1. Introduction

This part of the study investigates whether words produced by L2 learners in the delayed repetition task will be identified by monolingual English speakers (Research Question n. 4). Participants will take part in an intelligibility test (Field, 2005), in which they will be asked to transcribe the words they hear. The goal of this part of the study is to investigate how L2 pronunciation affects intelligibility for L2 VOT category (the intelligibility test has not been conducted yet).

6.2. Participants

Participants in the intelligibility test will be monolingual English speakers, who are currently taking classes at the University of Wisconsin-Platteville.

6.3. Stimuli

The stimuli will be English words, with initials /b/ and /p/, produced by Brazilian Portuguese learners of English as part of the production data of this study. The stimuli will consist of 10 minimal pairs (5 /b-p/ pairs followed by lower vowels and 5 /b-p/ pairs followed by a higher vowels). Only the most frequent words from the production data will be selected as the stimuli (word frequency was checked at Corpus of Contemporary American English – COCA [Davies, 2013]) (see Table 3 for the list of words for the intelligibility test). More deviant L2 data production (in terms of VOT values) from both the L and H groups will be used as stimuli (5 L2 speakers from the L group and 5 L2 speakers from the H group).

Table 3.

List of minimal pairs that will be used in the intelligibility task.

	pond-bond
	pack-back
Stop +	pan-ban
lower V	pat-bat
	path-bath
	pig-big
	pit-bit
Stop +	pull-bull
higher V	put-book
	push-bush

6.4. Procedure

Participants will hear individual words and they will be asked to write down each word they hear. The stimuli will be presented to the listeners as single words in a randomized fashion. They will be able to listen to the words again, if necessary.

6.5. Analysis of the data

Intelligibility will be measured as "the extent to which the acoustic-phonetic content of the message is recognizable by a listener" (Field, 2005, 401). It is expected that L2 VOT values in words will have an effect on intelligibility (e.g., longer VOT values for English voiceless stops will be identified more easily). I expect to have around 15 participants in this task (20 words x 10 L2 speakers (L, H) x 15 participants = 3,000 tokens.

In order to measure results from the intelligibility test, the responses from the monolingual native speakers will be classified by item according to whether the target word had been recognized. Mean identification and SD will be computed. In order to verify whether there is a difference in between L and H groups, in terms of intelligibility, a 3-factor mixed design ANOVA will be conducted with vowel height (low, high), and voicing (voice, voiceless) as the within-subject factors, and proficiency (L, H) as the between-subject factor. The proportion of correct identification will be the dependent variable.

In the next chapter, a conclusion of the proposal is presented, followed by a tentative structure for my dissertation, and a Timeline.

CHAPTER 7 - CONCLUSION

This study focuses on the perception and production of VOT categories of /p b k g/ in initial position in L2 English and Portuguese by late L2 Brazilian Portuguese learners of English, who had limited exposure to L2. The data will reveal whether L2 learners shift perception across language modes by switching between language-specific phonetic systems. It will also reveal whether improvement in L2 learning leads to improvement of perception and production of VOT values. The data will also inform whether phonetic drift occurs in L2 production and perception of Portuguese stops. Finally, this study will show the degree in which words produced with initial stops by L2 learners are intelligible, even though they may be accented. This study, therefore, will provide major contributions to the area of second language acquisition of VOT categories.

CHAPTER 8 - STRUCTURE OF DISSERTATION

Below, a proposed table of contents for my dissertation is presented, followed by a Timeline.

TENTATIVE TABLE OF CONTENTS

CHAPTER 9 - TIMELINE

The experiments on production and perception studies were designed, prepared, and conducted with L2 learners of English and monolingual Brazilian Portuguese speakers in Brazil this past July. I have worked on the information provided by them in the language proficiency test, and the language background questionnaire. In the Timeline below, I describe what remains to be done and I propose a schedule.

MONTH	GOALS
Sep 2014	Work on my proposal defense
Oct 2014	Defend my proposal Prepare the intelligibility test Work with IRB (intelligibility test at UW-Platteville)
Nov, Dec 2014 Jan, Feb 2015	Conduct the intelligibility test at UW-Platteville Work on the production data (measurement of VOT) Run stats for production data Continue writing
March, April, May 2015	Work on the perception data Run stats for perception data Continue writing
June, July 2015	Continue revising my dissertation Work on the intelligibility data Run stats for intelligibility data
Aug 2015	Hand in a final draft of my dissertation to the chair of the committee, upon his return to work
Sept, Oct 2015	After receiving comments from him, I'll revise and rewrite during the months of September and October
End of Oct 2015	Submit a final draft to the entire committee
Early Dec 2015	Defense

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APPENDICES

APPENDIX A

English language proficiency test

Proficiency Test for English Learners in Brazil

Subject n. _____

This test is based on the St. George International online English test, available online.

Please choose the correct answer.

---

1. What's _____ name?

❍ you ❍ she ❍ your ❍ yours

---

2. We're Chinese. We're _____ Beijing.

❍ for ❍ from ❍ in ❍ at

---

3. Jane's _____ nice and polite.

❍ a ❍ from ❍ very ❍ at

---

4. _____ a light?

❍ Do have you ❍ Do you got ❍ Have you got ❍ Are you have

---

5. Margaret _____ usually come by bus.

❍ doesn't ❍ isn't ❍ don't ❍ aren't

---

6. They _____ at home last night.

❍ aren't ❍ weren't ❍ don't ❍ didn't

---

7. What _____ you say?

❍ are ❍ have ❍ were ❍ did

---

8. Why _____ crying?

❍ are you ❍ you are ❍ do you ❍ you do

---

9. Where _____ to spend your holidays next summer?

❍ you are going ❍ are you going ❍ you will ❍ will you

---

10. _____never been to the theatre before.

❍ I'll ❍ I'm ❍ I can ❍ I've

---

11. Seiko watches _____ in Japan.

❍ are made ❍ made ❍ make ❍ are making

---

12. Where _____ when you met him?

❍ does he live ❍ was he live ❍ was he living ❍ is he living

---

13. If _____ I'll tell him you called.

❍ I'll see him ❍ I see him ❍ I'd see him ❍ I saw him

---

14. What _____ since you arrived.

❍ are you doing ❍ will you do ❍ would you do ❍ have you been doing

---

15. Wine _____ made in Italy for thousands of years.

❍ have been ❍ is being ❍ has been ❍ are being

---

16. My husband _____ live in Spain.

❍ use to ❍ was use to ❍ used to ❍ was used to

---

17. If I_____, I would go out more.

❍ wasn't married ❍ didn't marry ❍ wouldn't marry ❍ haven't married

---

18. I was very _____ in the story.

❍ interest ❍ interesting ❍ interested ❍ interests

---

19. You _____ come if you don't want to.

❍ don't need ❍ don't need to ❍ didn't need to ❍ didn't need

---

20. I _____ see you tomorrow.

❍ did ❍ will ❍ have ❍ does

---

21. _____is bad for you.

❍ Smoking ❍ The smoking ❍ To smoke ❍ Smoker

---

22. I _____ told him if I had known he was your brother.

❍ hadn't ❍ wouldn't ❍ wouldn't have ❍ don't have

---

23. He _____ living there for three years before they found him.

❍ had been ❍ has been ❍ might be ❍ could be

---

24. I wish you _____ all the time.

❍ don't shout ❍ won't shout ❍ wouldn't shout ❍ haven't shout

---

25. By the time you arrive, _____.

❍ he'll leave ❍ he'll have left ❍ he leaves ❍ he left

---

26. The house _____ built in the 16th century.

❍ might have been ❍ might be ❍ might have be ❍ might have

---

27. Don't forget _____ me a newspaper.

❍ buying ❍ that you buy ❍ to bought ❍ to buy

---

28. Whenever there was a visitor, the dog _____ to the door.

❍ will run ❍ is running ❍ would run ❍ was running

---

29. He is an executive in _____ .

❍ the car industry ❍ car industry ❍ car industries ❍ car industrial

---

30. Peter sold his car _____ save money.

❍ as a result ❍ so he ❍ in order to ❍ because to

---

31. He advised me _____ the doctor.

❍ that I see ❍ to see ❍ seeing ❍ see

---

32. I _____ travelling by bus.

❍ am not used to ❍ didn't used to ❍ used to ❍ do not used to

---

33. He didn't come last night. I wish that he_____.

❍ had ❍ did ❍ have ❍ has

---

34. I am going to a wedding. I need to _____.

❍ be cutting my hair ❍ cutting my hair ❍ have my hair cut ❍ get cut my hair

---

35. Which would you _____ have: gold or silver?

❍ prefer ❍ could ❍ rather ❍ better

---

36. My sister has been in the hospital. I wonder how she _____.

❍ is getting on ❍ gets on ❍ has got across ❍ is getting away

---

37. The man said he did not _____ to go by bus.

❍ care for ❍ bother about ❍ mind having ❍ much mind

---

38. Although he confessed to the crime, the judge let the boy_____.

❍ alone ❍ come in ❍ off ❍ forgive

---

39. I've never _____ that word before.

❍ gave away ❍ come across ❍ come over ❍ come into

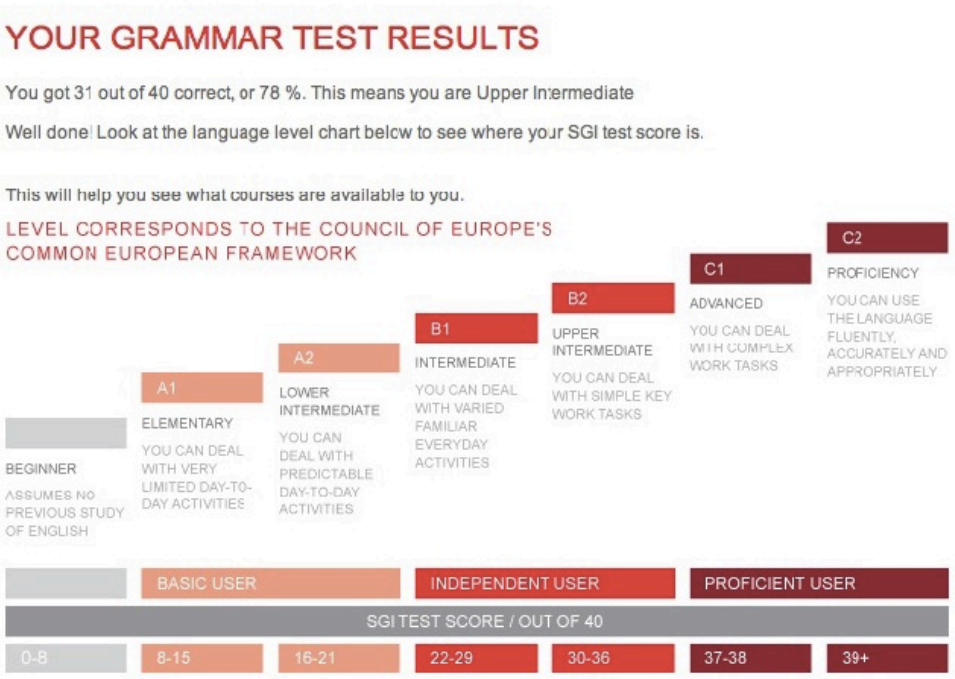
---

40. The student could not answer the question, so he_____.

❍ gave off ❍ gave into ❍ gave up ❍ gave away

APPENDIX B

L2 English proficiency levels, according to the Council of Europe's Common European Framework, used by the St. George International English Proficiency Test.



Source: St. George International – The Language Specialists website.
http://www.stgeorges.co.uk/online-english/online-english-test

APPENDIX C

Descriptive statistics for the English language proficiency test.

Number of participants (N)	36
Number of items (K)	40
Maximum possible score	40
Mean	26.94
Median	27.5
Mode	31
Standard deviation	8.82
Skewness	-0.19
Kurtosis	-1.241
Range	30
Minimum	10
Maximum	40

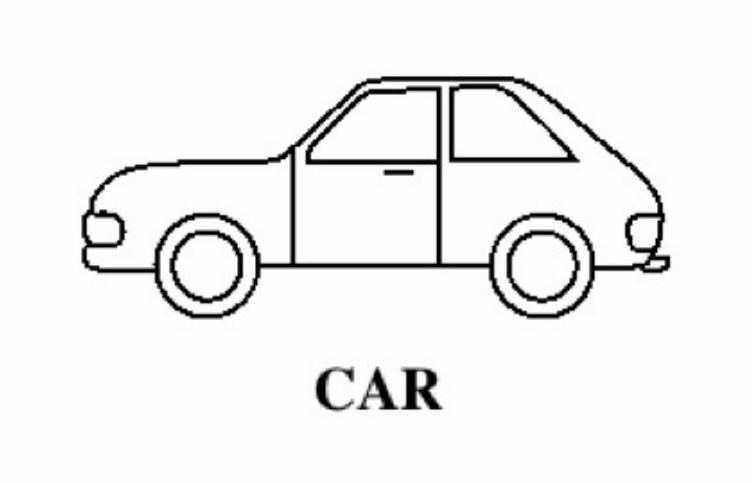
APPENDIX D

Placement of the L2 learners according to their scores in the English language proficiency test (1, lower-proficiency group; 2, higher-proficiency group)

Subject	Score	Proficiency
2	14	1
3	13	1
6	24	1
7	20	1
8	17	1
13	24	1
14	18	1
17	21	1
20	10	1
22	20	1
23	16	1
24	26	1
30	22	1
31	26	1
33	16	1
35	27	1
36	15	1
37	19	1
4	36	2
5	40	2
9	31	2
10	38	2
11	38	2
12	38	2
15	36	2
16	31	2
19	39	2
21	37	2
25	32	2
26	31	2
27	37	2
28	35	2
29	35	2
32	28	2
34	31	2
38	29	2

APPENDIX E

Examples of pictures and the corresponding target word in the English an Portuguese sessions.



APPENDIX F

LANGUAGE BACKGROUND QUESTIONNAIRE

(for Brazilian Portuguese learners of English)

The following survey seeks to explore your language history, and your feelings regarding the learning of English. Providing full and accurate answers to these questions is absolutely important for the success of this survey.
THANK YOU for taking the time to answer this survey.

Name: _____ Participant n. _____

Telephone: _____ email: _____

Date: _____

1. Do you have normal hearing? YES NO

2. Do you have normal or corrected vision? YES NO

3. Gender: M – F

4. Age: _____

5. Education:

( ) High school – complete / incomplete

( ) College degree – complete / incomplete

( ) Graduate program – complete / incomplete

6. Birth place (city/state): _____

7. Place where you live (city/state) _____

8. How long do you live there? _____

9. My native language is _____

10. Have you studied a language, besides Portuguese and English? YES NO

If YES, which one(s)? _____

For how long? _____

11. Age you started learning English: _____

12. How long have you studied English in a language school? _____

13. How long have you studied English in a public school? _____

14. Have you ever visited an English speaking country? YES NO

If YES, which one(s)? _____

For how long? _____

15. Have you ever studied or lived in an English speaking country? YES NO

If YES, where? _____

For how long? _____

16. In Brazil, have you had English teachers who were native speakers of English?

YES NO

If YES, for how long? _____

17. In Brazil, have you ever had any interactions with native speakers of English (outside the language school)? YES NO

If YES, please explain._____

For how long have you had contact with them (days, months, years)?

_____

18. How often have you interacted with native English speakers? Explain.

_____

YOUR SELF-PERCEPTION OF YOUR ENGLISH ABILITIES

Please estimate your English abilities by choosing between 1 (very poor) to 7 (excellent) for each row below:

	1 (very poor)	**2**	**3**	**4**	**5**	**6**	**7 (excellent)**
Speaking							
Writing							
Listening							
Grammar							
Vocabulary							
Pronunciation							
Reading							

YOUR SELF-PERCEPTION OF THE USE OF ENGLISH

Please estimate in percentage how much English you currently use in the following situations or places.

Ex. If, at the language school, you use English about 80% of the time you are there, you would choose "80%".

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
At the language school											
At home (e.g., homework)											
On the Internet											
At work											
Watching movies, videos, Youtube, and the like.											
With friends											
Classes online											
Other(s): _____											

YOUR SELF-PERCEPTION OF MOTIVATION

Please circle the number from 1(strongly disagree) to 7 (strongly agree) that best answers the question.

1. I am studying English because it will help me to get a better job.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

2. I am studying English because I love English/American culture.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

3. Studying English makes me feel important.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

4. I don't want to stop studying English.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

5. I like learning English.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

6. When I speak English, I try my best to not use Portuguese.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

7. I try to imitate the English accent as best as I can.

(strongly disagree) **1----------2----------3----------4----------5----------6---------7**(strongly agree)

THANK YOU VERY MUCH!

APPENDIX G

Consent form for L2 learners and monolingual Brazilian Portuguese speakers.

APPROVED BY UNIVERSITY OF AZ IRB.
THIS STAMP MUST APPEAR ON ALL
DOCUMENTS USED TO CONSENT SUBJECTS.
DATE: 04/18/14

Formulário de consentimento para participar de pesquisa da Universidade do Arizona

Título do estudo: *The stages of acquisition of English VOT by Brazilian Portuguese learners of English*
Nome dos investigador: Denise M. Osborne
Assistente de pesquisa: James E. Osborne

Este é um formulário de consentimento para participar em pesquisa. Ele contém informações importantes sobre o estudo, caso você decida participar. Por favor, leia a informação cuidadosamente. Sinta-se livre para discutir o estudo ou fazer qualquer pergunta antes de tomar a decisão de participar ou não.

Este estudo está sendo feito com o objetivo de entender melhor a percepção e produção dos sons em inglês por brasileiros que estão aprendendo inglês com qualquer nível de proficiência. Se você decidir participar deste estudo, você responderá a um questionário sobre seu background. Você irá identificar sons e palavras em português. Você também irá produzir palavras e frases em português. Essas palavras e frases serão gravadas. Este estudo levará por volta de 40 minutos para ser completado.

Sua participação é voluntária. Você pode se recusar a participar deste estudo. Se você decidir participar desta pesquisa, você poderá deixar a pesquisa a qualquer momento. Não importa qual decisão você tome, não haverá nenhuma penalidade. Sua decisão não afetará sua futura relação com a Universidade do Arizona. Se você é um estudante ou um funcionário da Universidade do Arizona, sua decisão não afetará suas notas ou sua posição como funcionário.

Não há antecipação de nenhum risco nesta pesquisa. Não há nenhuma compensação por participar desta pesquisa. Entretando, como gesto de apreciação, uma pequeno presente será ofertado, uma agenda americana. Este presente será dado a você somente no final da sua participação.

Esforços serão feitos para manter confidencial a sua informação relacionada com a pesquisa. Entretanto, pode haver circunstâncias onde esta informação deverá ser liberada. Por exemplo, informação pessoal com relação à participação nesta pesquisa pode ser revelada se for requerido pela lei do estado. Também, sua informação poderá ser revisada pelos seguintes grupos: Office for Human Research Protection, ou outra agência federal, estadual ou internacional, e the University of Arizona Institutional Review Board, ou Office of Responsible Research Practices.

Se você escolher participar desta pesquisa, você poderá interromper a participação a qualquer hora, sem penalidade ou perda de benefícios. Ao assinar este formulário, você não está abandonando nenhum direito pessoal legal por ser participante desta pesquisa.

Você pode se recusar a participar desta pesquisa sem qualquer penalidade ou perda de benefícios de que você possa ter direito.

O Institutional Review Board da Universidade do Arizona, que é responsável por pesquisas envolvendo seres humanos, revisou deste projeto de pesquisa e o aprovou, de acordo com as leis de regulamento estaduais e federais cabíveis e as políticas da universidade designadas a proteger os direitos e o bem-estar dos participantes desta pesquisa.

Version 04/16/2014

APPENDIX H

LANGUAGE BACKGROUND QUESTIONNAIRE
(for monolingual Brazilian Portuguese speakers)

The following survey seeks to explore your language history. Providing full and accurate answers to these questions is absolutely important for the success of this survey. THANK YOU for taking the time to answer this survey.

Name: _____ Participant n. _____

Telephone: _____ email: _____

Date: _____

1. Do you have normal hearing? YES NO

2. Do you have normal or corrected vision? YES NO

3. Gender: M – F

4. Age: _____

5. Education:

( ) High school – complete / incomplete

( ) College degree – complete / incomplete

( ) Graduate program – complete / incomplete

6. Birth place (city/state): _____

7. Place where you live (city/state) _____

8. How long do you live there? _____

9. My native language is _____

10. Do you speak another language besides Portuguese? YES NO

If YES, which one(s)? _____

11. Have you studied this language at school? YES NO

If YES, for how long? _____

What type of school? _____

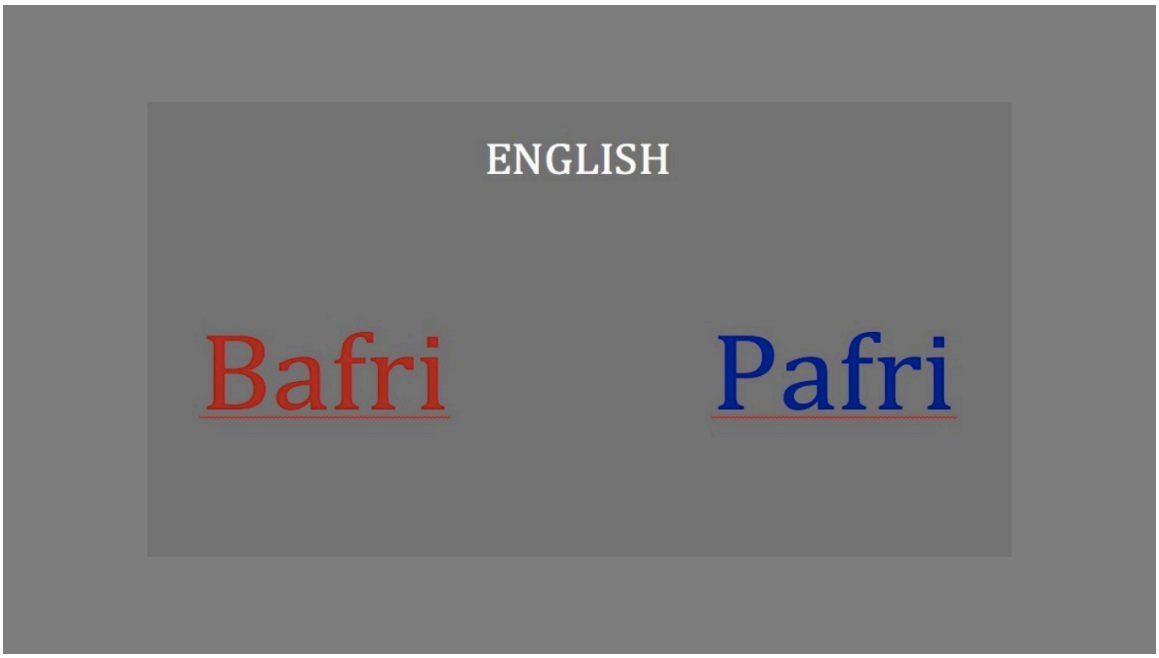
12. Have you lived in another place besides the city you live in now? YES NO

If YES, which city/state and for how long? _____

THANK YOU VERY MUCH!

APPENDIX I

A screen shot of the interface in the double phonetic boundary experiment in English.

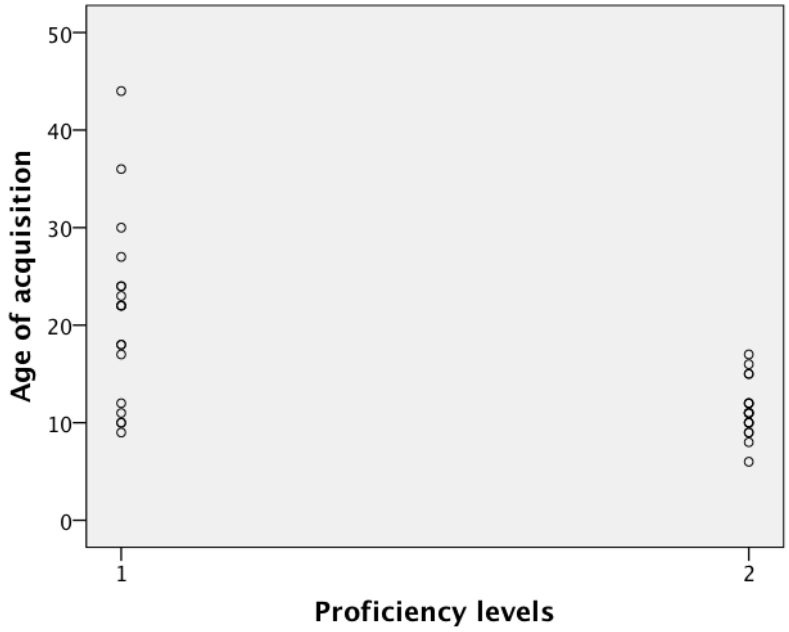


APPENDIX J

A screen shot of the interface in the double phonetic boundary experiment in Portuguese.

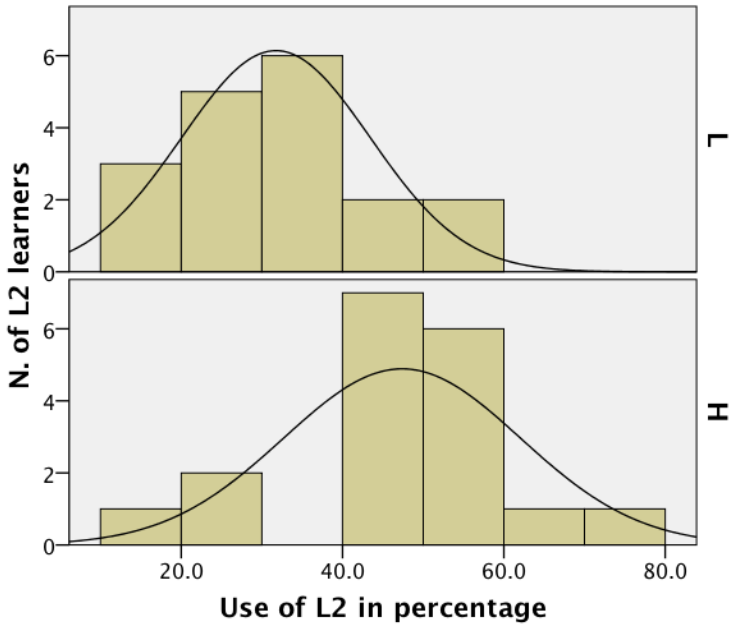
APPENDIX K

Distribution of age of acquisition of Brazilian Portuguese learners of English across two levels of proficiency (1=lower-proficiency group; 2=higher-proficiency group).



APPENDIX L

Distribution of L2 use of Brazilian Portuguese learners of English across two levels of proficiency (L=lower-proficiency group; H=higher-proficiency group).



APPENDIX M

Summary of the reported self-perception of English skills provided by lower and higher-proficiency groups of Brazilian Portuguese learners of English (*Ms, SDs*). They responded by choosing on a scale from 1 (very low) to 7 (excellent).

Self-reported English skills	***Lower group***	Speaking	3.78 (1.95)
		Writing	4.44 (1.42)
		Listening	4.44 (1.61)
		Grammar	4.33 (1.41)
		Vocabulary	4.33 (1.32)
		Pronunciation	3.67 (1.74)
		Reading	4.61 (1.50)
Self-reported English skills	***High group***	Speaking	4.39 (1.42)
		Writing	4.5 (1.42)
		Listening	3.89 (1.49)
		Grammar	4.39 (1.29)
		Vocabulary	4.56 (1.19)
		Pronunciation	4.33 (1.71)
		Reading	5.00 (1.37)

APPENDIX N

Responses provided by the lower and higher-proficiency groups (*Ms, SDs*) on their self-perception of motivation using a scale from 1(strongly disagree) to 7 (strongly agree).

Lower-proficiency group	*I am studying English because it will help me to get a better job.*	5.61 (1.85)
	I am studying English because I love the English/American culture.	5.5 (1.54)
	Studying English makes me feel important.	5.27 (1.78)
	I <u>don't</u> want to stop studying English.	6.38 (1.09)
	I like learning English.	6.44 (0.83)
	When I speak English, I try my best to not use Portuguese.	5.27 (1.23)
	I try to imitate the English accent as best as I can.	5.38 (1.49)

Higher-proficiency group	*I am studying English because it will help me to get a better job.*	6.16 (1.86)
	I am studying English because I love the English/American culture.	6.05 (1.67)
	Studying English makes me feel important.	5.22 (1.76)
	I <u>don't</u> want to stop studying English.	6.72 (1.10)
	I like learning English.	6.83 (0.85)
	When I speak English, I try my best to not use Portuguese.	6.33 (1.23)
	I try to imitate the English accent as best as I can.	5.72 (1.59)

APPENDIX O

Graphic representation of L2 learners' responses to Statement n. 6 (*When I speak English, I try my best to not use Portuguese*.). Participants used a scale from 1 (strongly disagree) to 7 (strongly agree).