Universidade Federal de Santa Catarina

Pós-Graduação em Letras-Inglês e Literatura Correspondente

THE PERCEPTION OF ENGLISH WORD-FINAL /l/ BY BRAZILIAN LEARNERS

Daniel Hight Moore, Jr.

Dissertação submetida à Universidade Federal de Santa Catarina em cumprimento parcial dos requisitos para obtenção do grau de

MESTRE EM LETRAS

FLORIANÓPOLIS

Março de 2008

Esta dissertação de Daniel Hight Moore, Jr., intitulada The Perception of English Word-Final /l/ by Brazilian Learners, foi julgada adequada e aprovada em sua forma final, pelo Programa de Pós-Graduação em Letras/Inglês e Literatura Correspondente, da Universidade Federal de Santa Catarina, para fins de obtenção do grau de

MESTRE EM LETRAS

Área de concentração: Inglês e Literatura Correspondente
Opção: Língua Inglesa e Lingüística Aplicada

_____
Dr. José Luiz Meurer
Coordenador

_____
Dra. Barbara Oughton Baptista
Orientadora e Presidente

BANCA EXAMINADORA:

_____
Dra. Rosana Denise Koerich
Examinador/a

_____
Dra. Denize Nobre Oliveira
Examinador/a

Florianópolis, 31 de março de 2008.

ACKNOWLEDGEMENTS

Thanks to be elaborated later. But for now, let me thank you!

ABSTRACT

THE PERCEPTION OF ENGLISH WORD-FINAL /L/ BY BRAZILIAN LEARNERS

DANIEL HIGHT MOORE, JR.

UNIVERSIDADE FEDERAL DE SANTA CATARINA
2008

Supervising Professor: Dr. Barbara Oughton Baptista

Very little research exists on Brazilians concerning English word-final /l/ beyond noting that they generally produce [u] (Baptista, 2001) or [w] (Avery & Ehrlich, 1992). This study investigated Brazilian ESL students' perception of English word-final /l/ (dark /l/).

Two groups of 20 Brazilian learners of English (intermediate and advanced) and one group of native speakers of English participated in the experiment. Three pairs of tests – two Categorial Discrimination Tests, two discrimination tasks, and two identification tests – examined perception of word-final /l/. The first test of each pair assessed word-final contrasts in both Portuguese and English; the second examined English-only contrasts. All results were analyzed by overall error rate, error rate per vowel context and error rate per test. Demographic data and and total error rate were explored for correlations.

No significant differences were found between the two groups of Brazilian students. Only for vowel contexts /o/ and /ɔ/ did Native Speakers perform significantly better than Brazilians. All groups' error rates were very low for vowel contexts /aɪ/ and /eɪ/

and quite high for /aʊ/. Results also suggest that Brazilians with exposure to older people from Rio Grande do Sul may perceive dark /l/ more accurately.

Number of pages: 78 (excluding appendix)

Number of words: 21,433 (excluding appendix)

RESUMO

THE PERCEPTION OF ENGLISH WORD-FINAL /L/ BY BRAZILIAN LEARNERS

DANIEL HIGHT MOORE, JR.

UNIVERSIDADE FEDERAL DE SANTA CATARINA

2008

Professora Supervisora: Dr. Barbara Oughton Baptista

Há pouca pesquisa a respeito de brasilieiros sobre /l/ no final de palavras inglesas alem da observação que geralmente se produz [u] (Baptista, 2001) ou [w] (Avery & Ehrlich, 1992). O objetivo de esta pesquisa foi investigar a percepção do /l/ no final de palavras inglesas ("dark /l/") por alunos brasileiros de ESL.

Dois grupos de 20 estudantes brasileiros de inglês (dos niveis intermediário e avancado) e um grupo de falantes nativos de inglês participaram em este experimente. Três pares de testes – dois Testes de Discriminação Categórica, dois Testes de Discrimínção, e dois Testes de Identificação – aferiram a percepção do /l/ no final de palavras. O primeiro teste de cada par examinou contrastes finais em palavras portuguesas e inglesas; o segundo examinou contrastes somente em palavras inglesas. Os resultados foram analizados por índice de erro global, de erro por vogal, e de erro por teste. Dados demográficos e índice de erro global foram explorados para investigar correlações.

Nenhuma diferença significante foi descoberto entre os grupos de brasileiros. O menor índice de erro do resultado dos falantes nativos de inglês foi estatisticamente

significativo somente nos contextos de /o/ e /ɔ/. O índice de erro de todos os grupos foi muito baixo nos contextos de /aɪ/ e /eɪ/ e muito alto em /aʊ/. O resultado também sugere que estudantes com muito contato com riograndenses velhos talvez percebam “dark /l/” com mais precisão do que os sem contato.

Número de páginas: 78 (excluindo anexos)

Número de palavras: 21.433 (excluindo anexos)

Table of Contents

List of Tables and Graphs

Appendix Graphs and Tables

Chapter 1

1.1 Introduction

> "Then said they unto him, Say now Shibboleth: and he said Sibboleth: for he could not frame to pronounce it right. Then they took him, and slew him at the passages of Jordan: and there fell at that time of the Ephraimites forty and two thousand."
>
> Judges 12:6, King James Bible

While phonological ignorance and phonetic imprecision no longer carry consequences so grave as those that befell the Ephraimites, one wrong sound in the wrong word can still make a strong impression. It is not for trivial reasons that learners of English are early advised to distinguish a) the word for the stretch of sand between scrub and ocean from b) a strong pejorative term for a woman. Similarly, students of Portuguese must either learn to say "pão" or run the risk of ridicule at the *padaria*. Most errors, of course, are not so serious. Context informs the listener of the difference between *bed* and *bad* even when a non-native speaker's vowel does not. Nevertheless, discrimination against those with "funny" accents persists.

Among native speakers of English, anyway, non-standard pronunciation is associated with a variety of responses, from pride to parody. For example, many speakers of African-American Vernacular English adopt its well-documented pronunciation of *the* as "da" for informal spelling and in commercial contexts. On the other hand, Chicago sports fans were gently mocked in Saturday Night Live spoofs of the 1990s for their pronunciations "da Bulls" and "da Bears." And mispronunciation of

word-final /l/ as /w/ has been played for laughs for years by Warner Brothers with its cartoon character Elmer Fudd.

Such exaggerated /l/ mispronunciation is rightly considered a speech disorder, but less extreme pronunciations of /l/ have been scorned in the past, among them the following. A well-noted feature of many dialects of English is the realization of /l/ as "clear" and "dark" allophones. Roughly speaking, clear /l/ occurs before vowels and /j/, while dark /l/ occurs everywhere else (Bladon and Al-Bamerni, 1976). Years ago, Daniel Jones (1958) made known a tradition of dark /l/ discrimination among teachers of voice and singing. Most voice coaches were once of foreign origin, and Jones posits that they were nonplussed by the murk of English dark /l/. Thus, they taught that solely the clear /l/ should be used in singing and on the stage. Earlier still, George Philip Krapp advised his readers in *The Pronunciation of Standard English in America* (1919) that the dark /l/ was a sound best avoided, lest the speaker be mistaken for one of the rabble. Now the opposite holds, and a word-final vocalized /l/ instead of a dark /l/ is somewhat stigmatized in both the US and in England (Wells, 1982). Some speech therapists even consider vocalized /l/ an error and worthy of intervention (Ball & Müller, 2005, p. 240).

Very little research has been done on Brazilian speakers of English with regard to English words ending in /l/ beyond noting that they generally produce [u] (Baptista, 2001) or [w] (Avery & Ehrlich, 1992). Perhaps this is simply because the English final /l/ is a difficult sound to master, particularly for Brazilians. In *Teaching Pronunciation*, Celce Murcia (1996) calls /l/ one of the most pedagogically challenging consonants in English. After mentioning the difficulties some Asians and Europeans have with the sound, she counsels the instructor to expect problems when teaching American post-vocalic /l/ to Brazilians in particular, due to their penchant to produce a vowel similar to

/o/ or /u/. In fact, due to the acknowledged articulatory difficulty four English consonants present for Brazilians, Baptista and Silva Filho chose not to study /θ/, /ð/, /r/, and /l/ production in an experiment concerning Brazilian English students' pronunciation of English word-final consonants (Baptista and Silva Filho, 1997). Only very recently, Baratieri (2005) completed what may be the first in-depth study of Brazilian production of English /l/.

Even less is known about Brazilians' perception of English word-final consonants. Recent studies in Portuguese-English interphonology have begun to address this. Kluge (2004) investigated perception of word-final nasals, while Bettoni-Techio's study (2005) concerned word-final alveolar stops. In fact, little is known about non-native perception of English word-final consonants at all – Flege's review (1995) purported to cover research of their perception but cited only studies of production.

Furthermore, although production and vocalization of English word-final /l/ have been studied quite a lot (cf. Sproat & Fujimora, 1975; Hardcastle & Barry, 1989; Recasens, 1996; Johnson & Britain, 2003; Baratieri, 2006), there are very few studies of its perception. Many that exist concern perception among Japanese learners of English (cf. Aoyama, et al., 2004), although there are others – Hardcastle and Berry (1989) and Gesuato (1996), for instance. This study aims to contribute new data and new insights to existing research into the English word-final /l/, to interphonology studies in Brazil, and, more broadly, to the study of final-consonant perception in phonology.

1.2 Contents of the document

This thesis is composed of six chapters, of which you are reading the first. Chapter 2 reviews the relevant scholarly literature concerning the phonology and phonetic realization of liquid consonants in English and Brazilian Portuguese. There is also a discussion of second language acquisition theory as it relates to perception of new phonetic categories. Chapter 3 describes in detail the methodology of the experiment, including information on the participants and the instruments used to assess their perception. Chapters 4 and 5 present and discuss at great length the results of the experiment and the subsequent statistical analysis. Chapter 6 concludes the thesis with notes on the findings and limitations of the study, and adds suggestions for further research.

Chapter 2 - Review of Literature

2.1 Introduction

Brazilian Portuguese is noted for having only two word-ending consonants that are produced as consonants: /s/ and /r/. A third word-ending "consonant," /l/, is generally pronounced as [u] or [w][1] at the ends of words in Brazilian Portuguese (Baptista, 2001; Mateus & d'Andrade, 2000; Cristófaro Silva, 2002), a pronunciation known as *vocalization* of /l/ (Carr, 1999). This presents a problem for Brazilian learners of English, since English final /l/ is often pronounced with the back of the tongue raised and with the lips unrounded as the so-called "dark L," which, except for a few Southern dialects (Mateus & d'Andrade, 2000; Cristófaro Silva, 2002), Brazilian Portuguese does not have. In some cases, producing /l/ as [w] in English words can lead to confusion in native English speakers, as with common words such as *go/goal, toll/tow/toe, roll/row, bowl/bow, you/you'll, call/cow* and so on. Personal observation and the observation of other English teachers has shown that this characteristic is persistent, although much less noticeable, in learners with high levels of experience with English, possibly partly due in some vowel contexts to a more native-like vowel quality in the pronunciation of more advanced learners. This chapter presents an overview of the relevant literature concerning laterals, their realizations in Portuguese and English, and phonological processes that affect them. The study of acquisition of second language sounds is also explored to provide a theoretical context for the experiment to follow.

[1] In this paper, quoted material has kept the original format and notation for phonetic transcriptions (normally brackets) and underlying representation (normally slashes). Sources differ on their notation of the final sound produced by Brazilians for words ending in /l/, with some transcribing [w] and some [u]. This is not a significant difference and sources are cited as they chose to transcribe it. In fact, Silva (2002) explicitly states "The symbol [w] corresponds to an articulation with the vocalic quality **u**" (my translation).

2.2 The lateral sounds

In traditional phonetic descriptions, the most common laterals - voiced lateral approximants - have been classified together with r-sounds (rhotics) as liquids because of their phonetic and phonological similarities. They both often form "a special class in the phonotactics of a language" (Ladefoged and Maddieson, 1996, p. 182) which allows them to figure in a large number of consonant clusters. Their similarities are such that many languages, such as Korean and Japanese, have only one liquid phoneme which has lateral [l] and [ɾ] allophones. In Korean, this liquid's realization ranges from an 'l' like sound to an 'r' like sound depending on its position within the syllable. In some dialects of Japanese [l] and [ɾ] alternate in free allophony. This alternation associates the classes naturally (p. 243). Liquids and rhotics, along with the other approximants /y/ and /w/, are also among the most sonorous of consonants.

Laterals considered on their own are usually described as distinguished by a mid-sagittal occlusion within the vocal tract around which air flows. Ladefoged and Maddieson broaden this characterization somewhat: a lateral is produced by contracting the tongue so that more air flows past one or both of its sides than over its center (p. 182). However, they go on to note that most laterals do not, in fact, allow air to pass over the tongue's center at all. Although in most of the world's languages, a dental or alveolar central occlusion is a central feature of laterals, it is important to note that as Ladefoged and Maddieson define *lateral*, a central occlusion is not a requirement.

In most of the world's languages in which they occur, laterals are produced with the tip of the tongue creating an occlusion in the dental or alveolar region (Maddieson, 1984, cited in Ladefoged and Maddieson). The occlusion typically extends no farther back than the premolars. Behind it, the body of the tongue is "relatively low in the mouth," which permits air to flow laterally. Other, less common realizations of voiced

lateral approximants are articulated by creating the medial occlusion with the blade or the body of the tongue, by placing the occlusion farther back towards the soft palate, with the tongue curled back, or with an incomplete closure. More unusually, the occlusion can occur between the tongue body and the velum.

Ladefoged and Maddieson claim that whatever the places of articulation, voiced lateral approximants appear to vary greatly with phonetic context and from speaker to speaker within a language (p. 191). Consonantal and vocalic environment and syllabic position all assert a goodly coarticulatory effect, partly because of the semi-vocalic quality that voiced laterals possess. One of the most extreme coarticulatory effects results in a "lateral," called dark /l/, nearly or completely lacking a central occlusion, as occurs in syllable-final /l/, in English and European Portuguese.

2.3 Clear /l/ and dark /l/

A particularly strong coarticulatory effect for /l/ can be found in a number of the world's languages. Recasens (1996, p.63), in a paper investigating this dichotomy in Romance languages, says that "two different varieties of /l/ are traditionally distinguished in the phonetics literature, that is, velarized, dark /l/ and non-velarized, clear /l/." He offers a diagram of German clear /l/ (from Ladefoged and Maddieson, 1986) and shows it to be articulated with the tip of the tongue at the alveolar ridge, and with the body of the tongue in a low-mid, or neutral, position. Dark /l/, from Russian, is diagrammed beside clear /l/ showing the rear of the tongue body retracted and raised toward the velum while, as with clear /l/, the tip maintains alveolar contact just behind the teeth.

In studies which pay particular attention to dark /l/, researchers are not so unambiguous about its velarization. Recasens is explicitly critical of the traditional

description of dark /l/ as "velarized." Rather, he points out that though not all varieties of dark /l/ in the languages in which it occurs involve the raising of the tongue's dorsum towards the velum, all share a movement of the tongue towards the back of the mouth. Recasens cites studies of a variety of European languages that have dark /l/ including Russian, Polish, Czech and English, stating that the back of the tongue body is often retracted towards the upper pharynx rather than the velum (p. 64). Because the tongue body retraction can be towards either the velum or the upper pharynx, Recasens prefers to classify the sound based on its acoustical qualities. Sproat and Fujimura (1993, p. 292), in a widely cited acoustic and articulatory study of English /l/, describe dark /l/ without mentioning velarization, writing only that "in dark /l/s the body of the tongue is more retracted than in light /l/s." Ultimately, they find the clear / dark dichotomy too simplistic. The authors suggest that because of the wide variety of articulations between lighter and darker varieties of /l/ that the light and dark allophones should not be treated as distinct, but rather as a continuum (p. 301). They also argue that temporal aspects of final /l/ play an important part in the distinction between the clear and dark poles of the continuum (p. 306). Finally, supporting Recasens' claim above, they state categorically that they found no evidence of the dorsum raising towards the velum in the English dark /l/ produced by their British and American speakers (p. 309).

2.4 The English lateral

Clear and dark /l/ have been recognized as distinct variations of English /l/ since at least 1919, when George Philip Krapp wrote in his *Pronunciation of Standard English in America* that the dark, or "thick" *l* was "to be avoided in cultivated speech" (p. 25). That /l/ realization varies with vowel context was noted by Krapp as well, but it is not entirely clear that the sound existed at all in English before the mid 19th century. In a

survey of historical literature on pronunciation, Johnson and Britain (2003) find almost no mention of variation the realization of /l/, and indeed find assertions to the contrary. They cite Wright (1905, p. 59), who wrote that 'l has gen. remained unchanged initially, medially and finally."

By the mid-twentieth century, though, clear/dark allophony was well established. Daniel Jones, in *The Pronunciation of English* (1958, p. 87-90) describes three varieties of /l/ "analogous to the positions of vowels" – clear and dark, which correspond to front vowel resonances and back vowel resonances, and neutral, which corresponds to /ə/. Continuing, he describes the clear and dark /l/ of various dialects of English, but does not discuss neutral /l/ further. More recent writings on English phonetics and phonology (Yallop; Giegerich; Carr; Ladefoged and Maddieson) and pronunciation (Celce-Murcia et al; Cruttenden and Gimson) are unanimous in noting the two types of English /l/, though their descriptions of dark /l/ vary. Giegerich and Cruttendon & Gimson describe a dark /l/ in which the tongue tip maintains contact with the alveolar ridge. Ladefoged and Maddieson claim the contrary, that the tip does not make alveolar contact, and add that it may be tucked behind the lower front teeth. Celce Murcia (p. 46), hews to the middle, stating that the tongue tip "may or may not remain in contact with the alveolar ridge." Many of the authors note that due to loss of apical contact with the alveolar ridge, syllable-final /l/ shows a tendency to vocalize in some dialects. This will be discussed at length in a later section.

2.5 The Portuguese lateral

Concerning European Portuguese (EP), Andrade (1999) says that for the past twenty years, /l/ has been "categorically associated with a non-velarized ('clear') allophone in syllable onset" (p. 543). In Brazilian Portuguese, too, the syllable initial /l/ is the clear allophone, simply described as a "laminodental voiced lateral" in Azevedo (1981, p. 36).

In contrast, word-final /l/ in European Portuguese is described by Mateus and d'Andrade as a lateralized velar consonant which is "systematically velarized [ɫ]," similar to the English version. Andrade concurs, describing a velarized ('dark') /l/ in coda position in EP. But in Brazilian Portuguese, final /l/ is realized as "the velar glide [w], and therefore, for example, "*mal* 'evil, badly' is realized as [máɫ] in EP and as [máw] in BP" (Mateus and d'Andrade, p. 12). This tendency is widely noted with regard to Brazilians' production of final /l/ in Portuguese, variously transcribed as [u], [w] or [ʊ] by Baptista (2001), Mateus and d'Andrade (2000) and Ladefoged and Maddieson (1996), respectively. This is a characteristic specific to Brazilian Portuguese, and is shared by a majority of its speakers.

Mateus and d'Andrade go on to note that in some southern dialects of Brazilian Portuguese, final /l/ is pronounced as in Portugal and, curiously, that in some Northern continental parts of Portugal, final /l/ is pronounced as in the majority of Brazil (p. 12).

2.6 Vocalization of word final /l/

It is important to note that the process of /l/ converting to [w] is not unique to Brazilian Portuguese. Sproat and Fujimura point out that in languages or dialects that have both clear and dark /l/, clear /l/ occurs only in syllable-initial position and dark /l/ only in syllable-final position (p. 309). The sound change of /l/ to a more vowel-like

segment is not limited to syllable-final position, however. Vocalization of /l/ in syllable-initial, syllable-final or word-final position has occurred historically or continues to occur in languages as varied as Dutch, Czech, Polish, Catalan, French and Italian (Recasens, 1996; M. J. Jones, 2005) as well as in a large number of dialects of British, Australian, New Zealand and American English (Johnson and Britain, 2003). In fact, several recent studies have been concerned with a trend towards vocalization of syllable-final /l/ among native speakers of various dialects of English in the United Kingdom, Australia and the United States (Johnson and Britain, 2003; various articles in Foulkes, 1999; Wells, 1994; Horvath & Horvath, 2002), many focusing on the recent development of "Estuary English" in England[2]. Among the Romance languages studied by Recasens, the distinction is made that word-final vocalization is rarer than syllable-final, preconsonantal vocalization. Both syllable-final and word-final /l/ are vocalized in the majority of dialects of Brazilian Portuguese.

A number of explanations have been proposed to account for vocalization of dark /l/ in the Romance languages and in English. One possibility is misperception. Concerning Romance languages in general, Recasens cites von Essen (1964), stating that dark /ɫ/ might be misperceived as [w] because of the "spectral affinity between the two consonants." Recasens also cites a spectral description from Lehiste showing that "F1 and F2 frequencies for word-final /w/ coincide to a large extent with those for word-final /l/" (p. 70). Ladefoged and Maddieson point out that Feldman (1972) finds Portuguese final /l/ similar acoustically to [ʊ]. And Ladefoged (2001, p. 184) goes so far as to say that when final laterals lose alveolar contact, they essentially *become* back unrounded vowels.

[2] Many of these studies, even though they concern various dialects in several native English speaking countries, point out the social undesirability or stigma among other native speakers of producing /l/ as [u] or [w].

Another possibility cited by Recasens is that vocalization is the result of an articulatory error, taking place when there is a loss of apical contact at the alveolar ridge, which, according to Grammont (1971, p. 204) leads to a tongue configuration like that of a high back vowel, and, consequently, a /u/ like sound. Interestingly, Ladefoged and Maddieson again cite Feldman (1972) in noting that final /l/ in Brazilian Portuguese includes a "vestigial" raising of the tip of the tongue towards the alveolar ridge in addition to raising the back (p.193).

2.7 Child phonological development

It is also worthwhile to consider child phonological development. According to David Crystal (1997), children show a preference for using [w] in the place of [l]. Typically, /l/ is also one of the later consonants to appear in children's phonological development, with some instances of /l/ "posing problems" at age 4. Some children, on the other hand, produce /w/ successfully before the age of 2, and all children produce /w/ by 3 years, 4 months (p. 242). Johnson and Britain (2003) also indicate that children learning English show a strong tendency to produce /w/ instead of /l/ and attribute this to the simpler articulatory structure of /w/ (p. 7). Even more interesting, according to the authors, is that regardless of the language being learned, if the phonological system features dark /l/ in rhyme children "almost invariably appear to vocalise it" (p. 15). In contrast, Cruttenden (1979, p. 18) offers a broader account of acquisition of a number of similar phones. "The development of distinctions among... /lrwj/ varies considerably." He claims a "common pattern of development is for an [l] *and/or* [my emphasis] a [w] to occur first, [w] subsequently splitting into [w] and [ɹ], and [l] into [l] and [j]." Similarly, Ferguson, et al (1992), largely basing their chart ("Age of Mastery of Consonants of American English") on data from Sander (1972) indicate that [w]

typically develops by age 3, with [r] and [l] appearing by age 6. Only some fricatives and affricates develop later. The late development of [r] and [l] is attributed to motoric difficulty experienced by younger children.

2.8 Theoretical context

English-speaking children's tendency to realize /l/ as [w] as they learn their native language lends strong support to the idea that /l/ is a more marked sound than /w/. Markedness is the idea that certain sounds and patterns in the world's languages are more "natural" than others (Katamba, 1989). More marked sounds will occur in fewer languages, and when the sounds of a language change, they will tend to change towards less marked sounds. The fact that /l/ has been subject to a process of vocalization in a number of languages also supports the notion of markedness. One of the least marked linguistic structures is the open CV syllable, which, according to Carlisle (1994), occurs in all of the world's languages. If the sounds of a language change towards the less marked, then it would be natural for more marked CVC syllables such as those ending in /l/ to change into CV syllables by realizing /l/ as the semi-vowel [w] or the vowel [u].

As stated earlier, English word-final /l/ is generally realized by Brazilians as [w]. To attempt to address the reasons for this realization, the broader issue of foreign accent in non-native speakers must be considered. Over the years, a number of theories have been proposed to account for foreign accent, with it being attributed to misperception, articulatory difficulty, or a combination of the two (Rochet, 1995). Many of the theories employ the psychological concept of equivalence classification (Leather and James, 1996). Possibly, the most complete of these is Flege's Speech Learning Model (SLM). In discussing equivalence classification, Flege (1995) states that "bilinguals tend to interpret sounds encountered in an L2 through the 'grid' of their L1 phonology" (p.

237). He goes on to state that this "virtually assures that non-native speakers will perceive at least some L2 vowels and consonants differently than do native speakers." These ideas make their way into the SLM's first and fifth hypotheses which deal with the nature of phonetic perception (H1) and the interference of L1 on L2 through equivalence classification (H5). The hypotheses state (Flege, 1995, p. 239):

> H1: Sounds in the L1 and L2 are related perceptually to one another at a position-sensitive allophonic level, rather than at a more abstract phonemic level.
>
> H5: Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually, the diaphones will resemble one another in production.

But how does the theory explain the fact that accent improvement occurs over time? The SLM attributes this change to experience with the new language, and to the idea that improved perception leads to improved production. At first, a sound will be assimilated to an L1 category, but with sufficient exposure to the new language, some differences will be perceived. H3 states (Flege, 1995, p.239):

> H3: The greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound, the more likely it is that phonetic differences between the sounds will be discerned.

This can be likened to learning to distinguish the difference in appearance between identical twins or learning to recognize the voice of a new acquaintance on the telephone[3]. Best (1995) says that the perceptual system becomes "attuned" and cites the work of James and Eleanor Gibson, two ground breaking psychologists who studied visual perception in support (p. 184). As relates to the sounds of a language, more

[3] The author has also noted the perhaps less usual experiences of learning to make finer distinctions among Asian facial features while traveling in Japan and the development over several years of a sensitivity to subtle variations in typeface design. It would be interesting to consider improvements in discrimination resulting from increased exposure over time in other sensory modes to investigate how universal such a cognitive process might be, as psychologists James and Eleanor Gibson have done with visual perception.

exposure leads to more sensitivity to new sounds and to changes in their mental representation. Flege believes that eventually, production of the new sounds reflects these changes. In particular, note the following hypotheses (Flege, 1995, p.239):

> H2: A new phonetic category can be established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and L2 sounds.
>
> H7: The production of a sound eventually corresponds to the properties represented in its phonetic category representation.

Using these hypotheses and others of the SLM as a framework, research can be designed to investigate acquisition and change in second language phonology.

Chapter 3 - Method

3.1 Introduction

The experiments described in this chapter were conducted in order to investigate the perception of English word-final /l/ by Brazilian students of English as a second language and to discover whether their perception of this phoneme improves with more exposure to, and advanced study of, English. To aid in this endeavor, two groups of Brazilians from extracurricular English classes at the Universidade Federal de Santa Catarina (UFSC) volunteered as participants, one group drawn from intermediate classes and another group from advanced. For the control group, native speakers of English from the US and England familiar with Brazilian Portuguese were found. For a variety of reasons detailed later, participants were informed of the purpose of the study.

This study is an expanded and elaborated version of a pilot study conducted in late 2005. The earlier study (Moore, 2005), like the current one, investigated the perception of a range of monosyllabic words ending in English [ɫ] or [u] versus Brazilian Portuguese [w], varying only the preceding context. Results of that study were inconclusive, but promising, and led to the current study's refinements, among which are a more exhaustive range of English and Portuguese words, and improvements in the recording to improve the consistency of the stimulus. The test was also expanded to explore the contrasts in different ways. In addition to the perception test, a survey was designed to investigate the participants' language backgrounds and exposure.

3.2 Objective of the study

To research the perception of English word-final /l/ by Brazilian learners of English, an experiment consisting of three tests of English-Portuguese and three of English-

English contrasts between word-final /l/ and back vowels was designed. Through this experiment, the following research questions will be investigated:

1. Whether native speakers of English and Intermediate and Advanced Brazilian learners of English all have difficulty perceiving a difference between English dark /l/ and various back vowels and diphthongs.
2. Whether Brazilians perceive differences less frequently than Native Speakers, since dark /l/ does not exist in the great majority of modern Brazilian Portuguese dialects.
3. Whether some phones before dark /l/ and /w/ make these word-final distinctions harder to discern than others.
4. Whether Advanced students perceive dark /l/ more accurately than Intermediate students.
5. Whether correlations exist between demographic data and test results.

3.3 Participants

For this study, forty intermediate and advanced students of English from UFSC's extracurricular language courses (described below) volunteered to participate as the experimental groups. For the control group, nine Portuguese-speaking native English speakers from the United States and England volunteered. All Brazilian participants were students of a native speaker of North American English. All participants were compensated only with the experimenter's effusive expressions of gratitude and a piece or two of candy or a can of fine English beer after the data was collected.

3.3.1 Questionnaire

To collect information about the participants, a questionnaire was developed for the two groups of Brazilians (See Appendix 1). Participants were asked their name, age, place of origin, regional accent, accents heard in youth, how they had learned their L2, whether they spoke languages other than Portuguese and English, experiences in foreign countries, exposure to L2 outside the classroom, etc. The questionnaire included items about potential influences on participants' "ear" for the sounds of their L2. Brazilians were asked about whether they had studied with teachers who were native speakers of English and whether they had been instructed specifically in the pronunciation of English word-final /l/, among many other questions. Since the focus of this study was perception of English dark /l/, Brazilians were asked if they had had much contact with Portuguese as spoken by older people from the state of Rio Grande do Sul, where the dark word-final /l/ of Continental Portuguese is stated by some authors (Mateus and d'Andrade, 2000; Azevedo, 1981) to persist.

Portuguese-speaking native speakers of English were asked their age, city and country of origin, regional accent, and time spent in Brazil.

3.3.2 Extracurricular English at UFSC

Among several other languages, courses in English as a second language are offered at UFSC to high school and university students, public servants, and members of the community in general. A highly successful program, "Extra," as it is called, boasts in the neighborhood of 45 English classes per semester, ranging from beginner to advanced, including courses in TOEFL preparation, advanced conversation and reading and interpretation of texts. More specifically, classes are offered at 8 numbered levels: levels 1, 2, and 3 (basic), levels 4, 5, and 6 (pre-intermediate), and levels 7 and 8

(intermediate). Advanced classes are called Advanced 1 and 2. Despite the Extracurricular program's description of level 6 as "pre-intermediate," a student who entered at level one and continued studying at "Extra" through level 6 would be in his or her 3rd year of study. Furthermore, the book used at this level, Interchange 3rd Edition, book 3, the last in a four book series, is described on Cambridge's website[4] as appropriate for "high-intermediate" students.

Most classes meet for one and a half hours twice a week, for a total of 45 hours of instruction per semester. The majority of English professors are students pursuing undergraduate or advanced degrees in English and quite often the professors ask their students to participate as subjects in their research. The pool of students is quite large; more than 600 students currently enroll in English classes per semester.

When students enroll in English classes at Extra, they are required to take a written placement test and undergo an evaluation of their speaking skills. A combination of scores on these two measures is used to assign the student to a level of English. Thereafter, there is no new formal evaluation by the program unless the student desires. No matter the level at which they enter, they may progress to the next level if they perform satisfactorily at the level at which they are initially assigned. This results in a potentially inconsistent student body, as one student enrolled, say, in Advanced 1, might have studied for four years in the Extracurricular course, while another might have entered the program at that level. Furthermore, the minimum score requred to pass from one level to another is 6 out of 10, although teachers are encouraged to hold students back at their discretion. Students are not locked into their assigned levels, however. Those who have not been assigned to a level of English appropriate to their

[4] http://www.cambridge.org/elt/catalogue/catalogue.asp?cid=1

abilities can, with the cooperation of the teachers involved, move to a level they feel is more suitable.

To address the potential variability in the level of students' abilities, their professor rated the students very good, normal, or weak for their level. This additional information will be used during statistical analysis.

3.3.3 Intermediate Group

The intermediate group was composed of 11 male and 9 female students from two level six English courses. They ranged in age from 15 to 53, with a mean age of 25.1 and a median age of 21.5. However, only three of the students were older than 26, and only two were younger than 20. Most reported no or very little (a few days to a few weeks) experience in an English speaking country, while 4 reported having spent more than three months in the US or England. Curiously, two of the students with significant experience in the United States were reported by their professor to be weak students for their level. They were also two of the oldest. Twelve of the twenty were from the Brazilian state of Santa Catarina, four from the state of São Paulo, and one each of the remaining four from the states of Minas Gerais, Bahia, Mato Grosso do Sul, and Rio de Janeiro. The student from Mato Grosso do Sul moved to Florianópolis when she was 9 years old. Most participants reported Portuguese accents that corresponded to their state of origin, with three reporting an "indeterminate" accent.

3.3.4 Advanced Group

The advanced group was made up of 12 female and 8 male students taken from Advanced 1 and Advanced 2 English classes at "Extra." In this group, students ranged in age from 18 to 65 with a mean age of 29.9, and a median age of 23. 14 of the

students were between the ages of 18 and 30. Sixteen of these students are from the state of Santa Catarina, two from Paraná, and two from Rio Grande do Sul. Again, most students described their accent as that of their state of origin, although three described their accents as indeterminate. In contrast to the intermediate group, 8 of the students reported having spent more than 3 months in an English speaking country, while three had visited for short periods of time.

3.3.5 Control Group

Florianópolis is a popular tourist destination, has several universities, and a large number of private English schools. As a result, it was not an immense challenge to find native speakers of English locally. However, finding native speakers with a large amount of exposure to Portuguese proved to be more difficult. Finding native speakers of English with similar linguistic backgrounds was, practically speaking, impossible.

The final control group was made up of nine native speakers of English, three women and two men from the United States, and four men from England. They ranged in age from 20 to 60 and all had been living in Brazil for at least three months at the time of the data collection. Importantly, all were competent speakers of Portuguese. None of the speakers from England described themselves as speakers of "Estuary English," a dialect noted, like Brazilian Portuguese, for its vocalization of word-final /l/.

3.4 Listening Tests

3.4.1 Listening Tests - General

To investigate Brazilians' ability to distinguish English final dark [ɬ] from Portuguese final [w] and from English final [u], three pairs of tests were devised – a Categorial Discrimination Test, a Same/Different Test, and an Identification Test. Each

test was made in a version that compared words ending in English [ɬ] to phonetically similar words ending in Portuguese [w], and a version that compared words ending in English [ɬ] to words ending in English [u] or [w]. This was done based on similarities between the English and Portuguese monophthongs /i/, /ɛ/, /ɔ/, /o/, /u/, and the diphthongs /aɪ/, /aʊ/ and /eɪ/. The phones differ slightly in their realizations (cf Azevedo, 1981, Baptista, 2001), but are similar enough to facilitate comparisons across the two languages with words that are distinct mainly in their final segment.

To prepare the tests, three exhaustive lists of phonetically similar one-syllable words were made, one of English words ending in [ɬ], one of English words ending in [u], and one of Portuguese words ending in [w] (see Appendix 4). The lists were combined to try to find ideal sets of words such as:

English	English	Portuguese
bile	bayou	baio
/baɪɬ/	/baɪu/	/baɪu/

Using various dictionaries[5] as guides, only "real" words or syllables were selected, although many of the words are not common. Where common words could be used, of course, they were preferred. For the English/Portuguese pairs, words such as *feel* and *fio* were contrasted, while for the English-only pairs, words such as *tow* and *toll* were compared. Because final *l*, and final unstressed *o* and *u* in Brazilian Portuguese can all be realized as [w] after vowels, it is possible to use words ending in all three of these letters. The tests did not use all possible words because of concerns about length of the test and because only words with good recordings were selected. The final list of words included English *bayou, bile, cawl, cell, feel, fell, foal, foe, foo, fool, go, goal, pal, peel,*

[5] Dicionário Aurélio Eletrônico, versão 3, 1999 and DIC Michaelis UOL, 2001 for Portuguese; Merriam-Webster's Online Dictionary, Cambridge Dictionary of American English, and the Oxford English Dictionary on Compact Disc, Second Edition for English.

pile, poo, pool, pow, shale, toll, tow, vow and *vowel*. Portuguese words were *baio, céu, cheio, fel, fio, gol, kol (*from *Skol), paio* and *piu*.

3.4.2 Recording procedure

Normally, different speakers are used to record the words or sounds ("tokens") used in speech perception tests, the idea being that variations across speakers will be disregarded and respondents will focus on the phonemic contrasts at hand. Catch trials reinforce this by varying only the speaker and not the token spoken. For this experiment, however, only one speaker was used, both because of the very subtle difference between the sounds to be examined, and because of the difficulty of finding people who are native speakers of both English and Portuguese with native accents in both languages. Furthermore, it was the opinion of the author that because of the subtle differences between the target sounds of [ɬ], [w], and [u], variation in the speaker could even become a distraction to listeners and interfere with the experiment's aim. To offset the limitation of using only a single speaker's speech, at least three recordings were made for each word. Thus, in any particular sequence of words, even in the catch trials, all three tokens were different recordings.

To investigate contrasts between Portuguese and English with a minimum of irrelevant phonetic interference, a single person who was a native speaker of both English and Portuguese was required, a "true" bilingual. An acquaintance of the researcher was found to be ideal for the experiment and agreed to participate.

Born in 1977 in Allentown, Pennsylvania in the United States, the speaker lived there to the age of five. In 1983, he moved to Florianópolis, Santa Catarina, Brazil, with his mother, where he took 3 months of Portuguese lessons, after which he continued learning Portuguese naturally while speaking primarily English at home. The speaker

left Florianópolis in 1996 to attend college in Providence, Rhode Island in the northeastern United States. After graduation, he moved to Portland, Oregon, where he remained for three years. In 2003, the speaker returned to Florianópolis and has lived there since returning. In the opinion of the experimenter, his accent in English is General American. His accent also clearly features dark /l/ in final position. In Portuguese, despite growing up in Florianópolis, his accent, as judged by several native speakers of Brazilian Portugugese, is not the stereotypical and distinctive accent of that city, but rather a more general Catarinense, the accent from the state of Santa Catarina. His final /l/ in Portuguese is the typical, rounded [w].

Monophonic recordings were made by the bilingual speaker on a Macintosh G5 in a quiet environment in the speaker's home at a sampling rate of 44.1 kHz and a resolution of 16 bits. All words were recorded at least three times using the sentence "a palavra é ___" in Portuguese, and "the word is ___" in English. All Portuguese examples were recorded first, followed by the English examples. The experimenter edited the recordings using Peak DV software on a Macintosh Powerbook G4, removing all sounds but the words to be used in the perception tests, and selecting the three best examples of the words when there were more than three good examples to choose among. All words were saved as individual files.

To put the words in the order in which they would be presented, another audio editing program, Cubase X, was used. First, each sound file was imported into Cubase. Next, each contrast to be investigated was ordered appropriately according to a randomization of the tokens in Microsoft Excel. Ordering was performed first for the CDT, then for the same/different and identification tests. More detail is provided in the descriptions of the individual tests.

After ordering, six files, one each for the six sections of the test, were exported from Cubase. In addition, for the CDT only, an introductory training file was created with words not used elsewhere, to demonstrate the four possible choices participants would have on the CDT and to give them a small amount of practice. These seven files were re-imported to Cubase, compressed slightly to minimize volume differences, normalized and exported again, and finally recorded on a CD.

3.4.3 Tests 1 and 2 - Categorial Discrimination Tests

The Categorial Discrimination Test (CDT) was originally designed to investigate vowel contrasts, but in this experiment it is used to investigate syllable-final phoneme contrasts, as has been done previously at UFSC (Koerich, 2002, Kluge, 2004). Significantly, to the author's knowledge, until now the CDT has primarily, if not exclusively, been used to investigate contrasts in a single language. One variation of the CDT used in this experiment differs from Flege's CDT in that phonemic contrasts across two languages were studied, rather than contrasts within a single language. This is similar to many perception studies which ask participants to distinguish between "native-like" and "non native-like" contrasts.

As in the 2005 pilot study, a modified version of the Categorial Discrimination Test (Flege, et al. 1994) was designed. In the CDT, to determine whether a listener perceives a contrast between two phonemes, minimal pairs are played in groups of three. Change trials consist of both items in one of six possible orders, while catch trials repeat only one of the items three times. For instance, a listener might hear the minimal pair "beat/bit" in the sequence "beat, beat, bit" for a change trial, and in the sequence "bit, bit, bit" for a catch trial.

For the Categorial Discrimination Tests used in this experiment, more words were used than in the pilot study. In the Portuguese/English CDT, the vowels compared were the diphthongs /eɪ/ and /aɪ/, and the monophthongs /i/, /ɛ/, /ɔ/, /o/ and /u/, featuring the following words or syllables, with Portuguese first: *cheio/shale, baio/bile, fio/feel, ceu/sell, kol/cawl, gol/goal*, and *ful/fool*. In the English only section, the diphthongs wer /aɪ/ and /aʊ/ and the monophthongs were /o/ and /u/. The contrasted words were *bile/bayou, vowel/vow, toll/tow* and *fool/foo(fu)*[6].

Each group of contrasts to be investigated was ordered into the eight possible orders that three options afford: AAA, BBB, ABA, BAB, ABB, BBA, BAA, AAB. This resulted in a total of 56 sets of three words for the English/Portuguese section, and 32 sets for the English section. When assembling the sets of word recordings, the beginnings of the words were separated by 1.2 seconds. To place the sets in their final order, a list of random numbers for all sections was generated using Microsoft Excel's random number generator, and the sets were sorted according to those random numbers. This was done separately for the six sections of the task. Finally, when placing the sets of three in their final presentation order, a pause of 2 seconds was placed between the third word of one set and the first word of the subsequent set.

3.4.4 Tests 3 and 4 - Same/Different Tests

In these tests, participants heard two words and were asked to identify whether they were the same word or different words. The words used in these tests were the same as in the CDTs. As with the CDTs, the first contrasts presented were between English and

[6] Although the syllable /fu/ is not necessarily a "proper" English word, it can be justified here on the following bases: it is the second syllable of the word *kung fu*; *foo* is widely used in computer science as an example variable name; it makes up part of the name of a popular band, the Foo Fighters; and as of August 19, 2007, Google finds almost 4 million web pages in English that contain the word *foo*.

Portuguese, varying only the word-final phone. In the second Same/Different Test, the contrasts were between English-only words ending in dark /l/ and [u/w].

3.4.5 Tests 5 and 6 - Identification Tests

The identification tests allowed for the use of more tokens, since only one good recording was needed for each item. In addition to the words used in the first and third tests, this test added the English *pile, peel,* and *fell,* and the Portuguese *paio, pio,* and *fel* to Test 5, the test examining contrasts between the two languages. The English-only test (Test 6) in this case featured words that ended in either [ɬ] or [u/ʊ], and participants were instructed to identify the final sound. The words *pow, pal, vow, vowel, bile, bayou, foe, foal, toe, toll, poo, pool, fool,* and *foo* were used one time each.

3.4.6 Instructions and Answer Sheet

A three-page answer sheet was provided for participants to mark their responses. For each test, columns were labeled appropriately for responses to that test. For the CDT, for example, the columns were labeled *1, 2, 3,* and *Same*. All participants were also provided with an instruction sheet (see Appendices 2 and 3).

Unlike other answer sheets the experimenter has seen used in phonology experiments, this experiment's answer sheet has blank spaces for students to fill in with an *X* for their responses. In other versions, response sheets contained rows of numbers, one for each trial, with numbers which participants were to circle, as in the following example:

1.	1	2	3	0
2.	1	2	3	0
3.	1	2	3	0

For the present study, based on the human ability to subitize, or grasp numbers up to four without using numeric words, it was decided to number only a header row, and thereby minimize distractions to participants.

	1	2	3	Same
1.				
2.				
3.				

Numerous studies on adults and children over the past sixty years have shown that humans have an innate, preverbal ability to grasp small numbers of items without having to use language. In simple terms, this means that if someone sees three dots on a page, she can say without hesitation and with absolute accuracy that there are three dots. Through a process called subitizing, we recognize cardinal numbers up to three or four "automatically, accurately and without conscious attention" (Wiese, 2003, p. 95). Through studies of infants using techniques similar to those used in studies of infant speech perception, it has been demonstrated that this ability is present as early as the first week of life (Wiese, 2003).

3. 5 Data

3.5.1 Data collection

All participants were given instructions on paper in both English and Portuguese and were asked to fill in a three-page paper response sheet. Due to the great phonetic similarity between some back vowels and dark /l/, to Brazilians' known tendency to vocalize syllable-final English /l/, and to well-documented developmental substitution of /w/ for /l/ in children whose L1 is English, the instructions pointed out that the subject of the study was word-final English /l/. Data was collected from the Brazilian participants in four half-hour sessions at UFSC's language lab, one session for each of

the four classes from which the participants were drawn. In the language lab, each participant used headphones to hear the audio, and all participants in each session heard the audio at the same time. All native English-speaking participants were met with individually for data collection, and all also used headphones to listen to the audio.

3.5.2 Data compilation

Responses from each answer sheet were manually entered into a Microsoft Excel spreadsheet, then verified for accuracy. Calculations in the spreadsheet compared the responses to a key to evaluate them, then placed an *X* where an incorrect response was recorded. Non-responses were entered as *nr*. As discussed below, because some tests included a high number of non-responses, they were eliminated from calculations on a systematic basis using an objective standard. Totals were calculated for correct, incorrect, and nr responses per test, per vowel, and for total error on all tests. Non-responses were dealt with in the calculations using pairwise deletion, a common method used by SPSS and Minitab. From these totals, percentage correct was figured per test, and per vowel, and for all tests combined.

Responses to the questionnaire were entered as well, and codified to facilitate statistical analysis.

3.5.3 Non-responses on the tests

Eight of the twenty intermediate respondents and nine of the twenty advanced respondents had at least one non-response on at least one of the six tests. Some of these non-responders had small numbers of non-responses. These low nr participants had at most two non-responses on any given test, and no more than a total of 5 non-responses (about 3%) out of the six tests' total of 168 questions.

In some cases, however, test-takers failed to respond to a much larger number of items. When they failed to respond to more than 20% of the items on any single test, the responses to the entire test in question were removed from the data set. The researcher believed that high non-response rates indicated substantial confusion on the part of the test-taker. For the various tests, the following numbers of tests were removed:

Test 1: 4 tests removed, nr rates of 100%, 60.71%, 42.86%, 26.79%
Test 2: 2 tests removed, nr rates of 59.38%, 84.38%
Test 5: 3 tests removed, nr rates of 80%, 35%, 35%
Test 6: 1 tests removed, nr rate of 75%

In the principal statistical analysis, non-responses and removed tests were addressed through pairwise deletion. This is one of two common techniques used by many statistical software packages, such as SPSS and Minitab, the software used for analysis in this study. Pairwise deletion works by simply eliminating any data point with missing data in calculations.

The other main technique, listwise deletion, deals with missing data in a sample by removing all data from a participant with any missing data above a certain low threshold, which here, as is typical in SPSS, was one percent. Listwise deletion was used for a secondary analysis. Both listwise and pairwise deletion can lead to bias (Allison, 2002), but "pairwise deletion may be necessary when overall sample size is small or the number of cases with missing data is large" (Garson, 2007). Since neither method for dealing with missing data is ideal, it was felt that if conclusions from both analyses were the same, the conclusions could be considered more robust.

Overall non-response rates, excluding tests that were entirely removed, were as follows:

Test 1: 0.50%	Test 4: 0.16%
Test 2: 0.25%	Test 5: 0.68%
Test 3: 0.36%	Test 6: 1.44%

Among the Native Speakers, there was only one non-response. It occurred in Test 2, the CDT of all English words. The Native Speaker's single non-response fell below the one percent cutoff used for the tests with listwise deletion.

3.5.4 Outliers

Among tests which included very few non-responses, there were also some instances of very high error rates on some tests that were objectively identified as outliers using Grubb's test and by making boxplots in the statistical software Minitab 15. High error rates, too, could indicate a high level of confusion, especially when a participant's error rate on other tests was not greatly different from other participants' error rates on the same tests. However, because there was no apparent measurement error, outliers were not removed from the data set.

3.6 Data Analysis

Data analysis was performed in a variety of ways using the statistical software Minitab 15, choosing appropriate tests based on the variables to analyzed. According to Brown (1988) and Rumsey (2007), when comparing Error Rates, which are interval scale variables, against participant groups, which are nominal scale variables, both the one-way ANOVA and the Kruskal-Wallis test are appropriate, depending on the distribution of data in the interval scale variable.

To prepare for analysis of total error rate, error rates by vowel, and error rates by test, the distribution of responses for each sample on each test was analyzed using the Ryan-Joiner test for normality. As with other normality tests, the null hypothesis is that the distibution is normal. A p value of less than the typical alpha of 0.05 means the null hypothesis should be rejected, and that the distribution is not normal (Spiegel &

Stephens, 1999). If the sample passed the normality test, a one-way ANOVA was used. If any group for a particular vowel or test failed the normality test, the distributions were plotted and compared visually. If the distributions were found to be roughly similar, the Kruskal-Wallis analysis of variance was used.

Both ANOVA and Kruskal-Wallis test only for whether differences exist among groups compared (Brown, p. 174-176). If either test finds significant differences, further tests are carried out. For significant ANOVA results, Tukey's test was chosen to analyze the data for differences, and for significant Kruskal-Wallis tests, the Mann-Whitney test was chosen. Both compare each pair separately and report significant differences between them.

For exploration of possible correlations between demographic data and Total Error Rates, most data could be compared with Pearson's product-moment correlation coeffecient. This procedure, better known as Pearson's *r*, tests two independent, natural interval scale variables that are normally distributed to discover how similarly they vary (Brown, p. 132, 136-37). For true dichotomous data vs. Total Error Rate, the point-biserial correlation coefficient was employed. In assumptions and interpretation, this test is similar to Pearson's *r* (Brown, p. 150). ANOVA tests were also performed to look into possible correlations in demographic data when a correlation coefficient was not appropriate, for instance, when comparing regional accent or region of origin.

Chapter 4 – Comparison of Vowel Contexts and Tests: Results and Analysis

4.1 Introduction

Because of the much higher number of responses that could be analyzed, results using all respondents' data with pairwise deletion are reported as the principal results. All groups' distribution of data were tested for normality with the Ryan-Joiner test, and the great majority were found to be normal at $p > 0.100$. As this is the most common finding, it will not be further noted in the text when discussing results. However, in a very few cases the p value was between 0.055 and 0.100. These will be noted in the text, but did not affect the decision to analyze with one-way ANOVA. In another few cases, p was found to be < 0.050 for one of the groups under consideration. As this would violate the normal distribution condition of ANOVA, after histograms were examined to compare data distribution shapes, Kruskal-Wallis was used instead. This, too, will be further noted as appropriate.

Results for each analysis will be presented in a table to facilitate comparisons and ease understanding. The table will first present the mean error rate by group in two columns. The first column, labeled "Principal" will contain the mean error rate with non-responses handled with listwise deletion. The second column, labeled "No NRs" will contain the mean error rate with results that contained more than 1% non-responses removed entirely from the analysis by listwise deletion. Below the means will be the analyses, first the principal analyses with pairwise deletion, then the alternate analyses with listwise deletion. For ANOVA and Kruskal-Wallis, p values and conclusions will be listed, then, if a follow-up analysis was performed, the results of Tukey's test or the Mann-Whitney test as appropriate.

After all results are discussed individually, they will be presented in a graphical and numerical summary, to better assess the results as a whole.

4.2 Statistical Analysis

4.2.1 Analysis of Total Error Rate

Table 4.2.1 Analysis of Total Error Rate

Means		Principal	No NRs
	Intermediate	17.46%	16.43%
	Advanced	18.53%	17.91%
	Native Speakers	9.73%	9.73%
Analyses			
One-way ANOVA:	$F(2, 46) = 7.79$, $p = 0.001$		
	at least two groups significantly different		
Tukey's test:	Intermediate and Advanced not significantly different		
	Native Speakers erred significantly less than Intermediate and Advanced		
Alt ANOVA:	$F(2, 32) = 8.04$, $p = 0.001$, first finding supported		
Alt Tukey's test:	first finding supported		

To begin, the Total Mean Error rates of the three groups were compared. Initial examination of the data shows that the native speakers' total mean error rate (9.73%) was much lower than that of either of the groups of Brazilians. A rather unexpected result, however, was that the total mean error rate of the Advanced group (18.53%) was slightly higher than that of the Intermediate group (17.46%). Surprisingly, this pattern would be observed in many subsequent comparisons.

The Ryan-Joiner normality test found all three groups to be normal, but the Intermediate group was normal at $p = 0.068$, and the Advanced group at $p = 0.84$. Both of these values are above the alpha level of 0.05, but not by much. The removal from each group of the response with the most extreme error rate affects the normality test significantly, resulting in a p value greater than 0.100. This will be discussed at length

later for the case of the Intermediate results. For the principal analysis and the retest discussed below, these extreme values were left in place.

A one-way ANOVA performed on the total error rate of each group revealed that at least two among the Intermediate, Advanced, and Native Speakers differ significantly at this broad level of assessment. The test indicated a very high level of confidence in the conclusion ($p = 0.001$). Retesting with non-responders removed confirmed the result at the same level of significance ($p = 0.001$).

To determine which groups differed significantly, Tukey's test was performed. As might be expected from a glance at the means, the Native Speakers' mean error rate was shown to be significantly lower than that of either Brazilian group, while the mean error rates of the Intermediate and Advanced groups were not found to be significantly different. These conclusions were supported by the re-run of Tukey's test.

4.3 Analysis of Total Error rate per vowel

To examine the effect of preceding vowel context on the results of the various tests, total error rates for each context were compared among the Intermediate, Advanced and Native Speaker groups.

4.3.1 /ɛ/ Error Rate vs. Class

Table 4.3.1 /ɛ/ Error Rate vs. Class

Means	Principal	No NRs
Intermediate	14.48%	12.95%
Advanced	21.63%	19.79%
Native Speakers	13.19%	13.19%
Analyses		
One-way ANOVA:	$F(2, 46) = 1.92$, $p = 0.158$, no significant differences	
Alt ANOVA:	$F(2, 32) = 1.27$, $p = 0.293$, first findings supported	

The vowel /ɛ/ appears before dark /l/ in 16 test tokens in Tests 1, 3 and 5, being 14.3% of the items in Tests 1 and 3, and 10% of the items in Test 5. Means of the Intermediate group (14.48%) and Native Speakers (13.19%) are very similar, while the Advanced (21.63%) is well higher. But one-way ANOVA results comparing individual /ɛ/ total error rates by group show no significant differences among them ($p = 0.158$).

Retesting without non-responders also produces non-significant results ($p = 0.293$), but, curiously, the Intermediate mean error rate (12.95%) is slightly lower than the Native Speakers mean error rate (13.19%). The Advanced mean error rate (19.79%) remains higher than both.

4.3.2 /ɔ/ Error Rate vs. Class

Table 4.3.2 /ɔ/ Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	28.49%	29.32%
	Advanced	34.05%	33.93%
	Native Speakers	6.35%	6.35%
Analyses			
One-way ANOVA:	$F(2, 46) = 10.25$, $p = 0.000$ at least two groups are significantly different		
Tukey's test:	Intermediate and Advanced not significantly different Native Speakers erred significantly less than Intermediate and Advanced		
Alt ANOVA:	$F(2, 32) = 10.48$, $p = 0.000$, first finding supported		
Alt Tukey's test:	first finding supported.		

The vowel /ɔ/ precedes dark /l/ in 14 items in the first five tests, making up 14.3% of the items in Tests 1 and 3 and 10% of the items in Test 5. Means of the groups are more extremely different between Brazilians and Native Speakers than in any other test: Intermediate, 28.49%; Advanced, 34.05%; and Native Speakers, 6.35%. A one-way ANOVA comparing these means showed, not surprisingly, that at least one of the

groups is significantly different from the others (p = 0.000). Tukey's test showed no significant difference between the Brazilian groups, and found that the Native Speakers' error rate was significantly lower.

Removal of non-responders lowered the Intermediate mean to 29.32% and the Advanced mean to 33.93%. ANOVA re-run with non-responders removed showed a similarly minimal p value of 0.000, confirming the initial results. The re-run of Tukey's test also supported the original conclusion.

4.3.3 /i/ Error Rate vs. Class

Table 4.3.3 /i/ Error Rate vs. Class

Means	Principal	No NRs
Intermediate	24.53%	18.75%
Advanced	23.75%	20.31%
Native Speakers	16.67%	16.67%
Analyses		
Kruskal-Wallis:	p = 0.151 adjusted for ties, no significant differences	
Alt Kruskal-Wallis:	p = 0.429 adjusted for ties, first findings supported	

As above, a normal distribution was rejected by the Ryan-Joiner normality test, here for the Intermediate group ($p < 0.010$). Examination of histograms shows more or less similar shapes among the three groups' distributions, so analysis was again conducted with the non-parametric Kruskal-Wallis test.

The Kruskal-Wallis test indicates (p = 0.151 adjusted for ties) that the medians of the three groups do not differ significantly. When the test is re-run with non-respondents removed, the conclusion is the same (p = 0.429 adjusted for ties).

4.3.4 /o/ Error Rate vs. Class

Table 4.3.4 /o/ Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	23.18%	22.77%
	Advanced	20.98%	23.44%
	Native Speakers	9.39%	9.39%
Analyses			
One-way ANOVA:	$F(2, 46) = 6.08$, $p = 0.005$		
	at least two groups are significantly different		
Tukey's test:	Intermediate and Advanced not significantly different		
	Native Speakers erred significantly less than Intermediate and Advanced		
Alt ANOVA:	$F(2, 32) = 6.13$, $p = 0.006$, first findings supported		
Alt Tukey's test:	first findings supported		

The vowel /o/ precedes dark /l/ in 32 items in all six tests, making up 14.3% of the items in Tests 1 and 3, 25% of the items in Tests 2 and 4, 10% of the items in Test 5, and 37.5% of the items in Test 6. Means of the groups are lower as the "level" of English increases: Intermediate, 23.18%; Advanced, 20.98%; and Native Speakers, 9.39%. A one-way ANOVA comparing these means showed that at least one of the groups is significantly different from the others ($p = 0.005$). As in the overall results, Tukey's test found no significant difference between the Brazilian groups, and showed that the Native Speakers' error rate was significantly lower.

But again we see no meaningful difference without the non-responders. Their removal lowered the Intermediate mean to 22.77% while increasing the Advanced mean to 23.44%. ANOVA re-run on the new means showed a small p value of 0.006, confirming the initial result of at least one difference among the groups. The statistical conclusions of the second run of Tukey's test are the same as the first run.

4.3.5 /u/ Error Rate vs. Class

Table 4.3.5 /u/ Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	11.31%	9.79%
	Advanced	11.29%	10.00%
	Native Speakers	5.93%	5.93%
Analyses			
One-way ANOVA:	$F(2, 46) = 3.68$, $p = 0.033$ at least two groups are significantly different		
Tukey's test:	Intermediate and Advanced not significantly different Native Speakers erred significantly less than Intermediate and Advanced		
Alt ANOVA:	$F(2, 32) = 2.68$, $p = 0.084$ no significant difference among the groups. The conclusion of the first test is not supported.		

The vowel /u/ precedes dark /l/ in 30 of the test items across all six tests. One-way ANOVA test results for this phoneme combination showed that at least two of the groups are different (p = 0.033). The Intermediate and Advanced groups' means are quite close at 11.31% and 11.29% respectively, and the Native Speakers' means are quite low at 5.92%. Tukey's test confirms that the difference between the Native Speakers and Brazilians is statistically significant.

The means of the Intermediate and Advanced groups are slightly lower without the non-responders, at 9.79% and 10.00% respectively. Though the mean of the Native Speakers is still quite a bit smaller (5.93%) than that of both Brazilian groups, this drop is enough for the re-run ANOVA to find no significant differences (p = 0.084).

4.3.6 /aɪ/ Error Rate vs. Class

Table 4.3.6 /aɪ/ Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	3.04%	2.38%
	Advanced	5.60%	4.72%
	Native Speakers	2.59%	2.59%
Analyses			
One-way ANOVA:	$F(2, 46) = 2.14$, $p = 0.129$, no significant differences		
Alt ANOVA:	$F(2, 32) = 1.18$, $p = 0.320$, first finding supported		

The vowel /aɪ/ appears before dark /l/ in 30 test tokens across all six tests, comprising 14.3% of the items on Tests 1 and 3, 25% of items on Tests 2 and 4, 20% of the items on Test 5, and 12.5% of the items on Test 6.

One-way ANOVA results comparing individual total error rates on these test items to the three groups shows no significant differences among them ($p = 0.129$). Retesting without non-responders confirms that finding ($p = 0.320$).

4.3.7 /aʊ/ Error Rate vs. Class

Table 4.3.7 /aʊ/ Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	41.61%	44.64%
	Advanced	41.46%	40.63%
	Native Speakers	28.47%	28.47%
Analyses			
One-way ANOVA:	$F(2, 46) = 3.22$, $p = 0.049$ at least two groups are significantly different		
Tukey's test:	No significant differences were found		
Alt ANOVA:	$F(2, 32) = 3.58$, $p = 0.040$, first finding supported		
Alt Tukey's test:	Native Speakers erred significantly less than Intermediate		

The vowel context /aʊ/ is a special case among the contexts studied in this experiment. Contrasts were examined for /aʊ/ primarily between the English-only *vow* and *vowel*, which appeared in 14 of 16 instances. In the other two instances, *pow,* /paʊ/,

was contrasted with *pal,* /pal/, (according to Merriam-Webster, /pæl/ according to the OED). These contrasts are obviously not precisely comparable to each other, which will be discussed in detail later. Note: one respondent's test was entirely removed from this analysis because of a very high non-response rate (75%).

One-way ANOVA performed on the Total Error Rate /aʊ/ found that at least two groups were different, but not with great certainty ($p = 0.049$). Oddly, Tukey's test did not confirm this. Results of a second ANOVA using listwise deletion matched the first at a fair confidence level of $p = 0.04$. Here, Tukey's test found that the Native Speakers erred significantly less than the Intermediate group, but found no other differences.

4.3.8 /eɪ/ Error Rate vs. Class

Table 4.3.8 /eɪ/ Error Rate vs. Class

Means	Principal	No NRs
Intermediate	4.16%	2.55%
Advanced	5.06%	3.57%
Native Speakers	3.97%	3.97%
Analyses		
Kruskal-Wallis:	$p = 0.815$ adjusted for ties, no significant difference	
Alt Kruskal-Wallis:	$p = 0.761$ adjusted for ties, first findings supported	

The diphthong /eɪ/ appears before dark /l/ in Tests 1, 3, and 5, totaling 14 tokens per respondent. Eight instances occur in Test 1, 4 in Test 3 and 2 in Test 5.

The Ryan-Joiner normality test rejected the null hypothesis that the distribution was normal for the Advanced group ($p < 0.010$), and barely confirmed normality for the Intermediate ($p = 0.055$). Examination of histograms showed more or less similar shapes, so the Kruskal-Wallis one-way analysis of variance was employed to compare the three groups. The results indicate very strongly ($p = 0.815$ adjusted for ties) that the

medians of the three groups do not differ significantly. The retest results are similar (p = 0.886 adjusted for ties) and support the findings of the principal analysis.

Though the Kruskal-Wallis analyzes for equality of medians, not means, a comparison of the means found using pairwise deletion to the means using listwise deletion is very interesting. In the principal analysis, the means are Intermediate, 4.16%; Advanced, 5.06%; and Native Speakers, 3.97%. The pattern is similar to results for /ɛ/, with Intermediate and Native Speaker group means differing little while the Advanced group errs much more.

Listwise deletion has a surprising effect - the Advanced mean error rate drops below the Native Speaker rate (3.57% and 3.97% respectively), and the Intermediate rate is cut by almost a third to a level greatly below that of both other groups (2.55%).

4.4 Error Rates Compared by Test

4.4.1 Test 1 Error Rate vs. Class

To examine more closely the differences between the groups in the hopes of discovering whether test type or number of languages in a test had a strong effect on error rates, each test was analyzed separately. It is hoped that this will also help determine the reliability of the tests - if all error rates are similar across the tests, that will give some indication.

Table 4.4.1 Kruskal-Wallis Test: Test 1 Error Rate vs. Class

Means	Principal	No NRs
Intermediate	14.20%	12.00%
Advanced	15.61%	15.03%
Native Speakers	7.74%	7.74%
Analyses		
Kruskal-Wallis:	p = 0.128 adjusted for ties, no significant differences	
Alt Kruskal-Wallis:	p = 0.142 adjusted for ties, first finding supported	

Test 1 is the most extensive of the six tests, using 8 tokens each of all vowels in the study except /aʊ/ before dark /l/ in a Categorial Discrimination Test of both English and Portuguese.

A total of four participants' responses were removed from Test 1 due to high non-response rates: 26.8% and 100% for Intermediate, and 42.3% and 60.7% for Advanced. The Ryan Joiner test roundly rejected normality for the Intermediate group ($p < 0.010$), due solely to the presence of an outlier with a very high error rate of 58.18%. After histograms of the three groups were examined and found to have similar shapes, the non-parametric Kruskal-Wallis test was used to check for differences.

KW does not find a difference among groups ($p = 0.128$ adjusted for ties) when using data from all respondents. Medians, for whose equality Kruskal-Wallis tests, were 11.81% for Intermediate, 10.71% for Advanced, and 7.14% for Native Speakers. The means were all higher and are provided for comparison with what is reported in ANOVAs elsewhere. The means were 14.20% for Intermediate, 15.61% for Advanced, and 7.74% for Native Speakers. In Test 1, the Native Speakers performed much better than the Brazilians, while the Brazilians performed similarly, but the results of the Kruskal-Wallis test do not indicate a sufficient level of statistical significance to generalize beyond this sample.

Retesting without non-responders found no differences among the groups at a similar p value of 0.142 adjusted for ties. A third retest to remove the outlier mentioned above is discussed briefly below, and at length in Appendix 5.

4.4.2 Test 2 Error Rate vs. Class

Table 4.4.2 One-way ANOVA: Test 2 Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	17.83%	18.75%
	Advanced	19.79%	20.57%
	Native Speakers	13.58%	13.58%
Analyses			
One-way ANOVA:	F (2, 44) = 1.59, p = 0.216, no significant differences		
Alternate ANOVA:	F (2, 32) = 1.68, p = 0.202, first finding supported		

Test 2, like Test 1, was a Categorial Discrimination Test, but here only English words were used. Only four vowel contexts were analyzed - /aɪ/, /aʊ/, /o/ and /u/. Eight tokens were presented of each for a total of 32 items. Two Advanced participants were removed from Test 2 due to high non-response rates of 59.4% and 84.4%.

Means of the three groups were Intermediate, 17.83%, Advanced 19.79%, and Native Speakers, 13.58%, but the differences were too small for a one-way ANOVA to find a significant difference (p = 0.216). An ANOVA re-run using listwise deletion instead of pairwise deletion produced similar results (p = 0.202).

4.4.3 Test 3 Error Rate vs. Class

Table 4.4.3 Kruskal-Wallis Test: Test 3 Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	14.46%	13.78%
	Advanced	17.72%	16.96%
	Native Speakers	10.71%	10.71%
Analyses			
Kruskal-Wallis:	p = 0.019 adjusted for ties, at least one significant difference among the groups		
Mann-Whitney:	Native Speakers erred significantly less than Advanced No significant difference between Intermediate and either of the other groups		
Alt Kruskal-Wallis:	p = 0.030 adjusted for ties, first finding supported		
Mann-Whitney	first findings supported		

Test 3 was a forced-choice test of seven vowel contexts with both English and Portuguese words. For each vowel context, there were two words per language.

No tests were removed for a high rate of non-responses, but the Ryan-Joiner normality test failed for the Advanced group (p = 0.032), so, after histograms were compared and found to be of roughly similar shape, the Kruskal-Wallis test was used.

Kruskal-Wallis found at a significant level (p = 0.019) that at least two of the groups differed, so the Mann-Whitney test was run to compare the groups. The median of Native Speaker results (10.71%) is significantly lower than that of Advanced students (17.86%), but not significantly lower than the median of Intermediate speakers (14.29%). However, the slightly lower median result of Intermediate students, between the medians of the other groups, is not significantly different from either the Advanced *or* the Native Speakers. Means were Intermediate, 14.46%, Advanced, 17.72%, and Native Speakers, 10.71%, identical to the median. Results from the groups without non-responses were similar (p = 0.030), and support the same conclusion.

4.4.4. Test 4 Error Rate vs. Class

Table 4.4.4 One-way ANOVA: Test 4 Error Rate vs. Class

Means	Principal	No NRs
Intermediate	11.88%	12.05%
Advanced	10.02%	7.29%
Native Speakers	6.94%	6.94%
Analyses		
One-way ANOVA:	F (2, 46) = 1.25, p = 0.295, no significant difference	
Alt ANOVA:	F (2, 32) = 2.22, p = 0.125, first finding supported	

Test 4, an English-only same/different test, was one of two tests with only 16 items. It tested four tokens each of four vowels before dark /l/: /aɪ/, /aʊ/, /o/ and /u/. Results from all participants' tests were considered. Mean total error rates were 11.88% for

Intermediate, 10.02% for Advanced, and 6.94% for Native Speakers. A one-way ANOVA comparing these results showed no significant differences among the groups (p = 0.295). Retesting on results without non-responders raised the Intermediate mean slightly and lowered the Advanced mean greatly, thus increasing the p value of the ANOVA to 0.125.

4.4.5 Test 5 Error Rate vs. Class

Table 4.4.5 One-way ANOVA: Test 5 Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	20.08%	18.93%
	Advanced	25.79%	23.82%
	Native Speakers	12.22%	12.22%
Analyses			
One-way ANOVA: different	F (2, 43) = 4.96, p = 0.012, at least two groups significantly		
Tukey's test:	Intermediate and Advanced not significantly different Native Speakers erred significantly less than either Intermediate or Advanced		
Alt ANOVA:	F (2, 32) = 4.16, p = 0.025, first finding supported		
Alt Tukey's test:	Results are different from principal analysis Native Speakers erred significantly less than Advanced Intermediate not significantly different from Advanced or Native Speakers		

Test 5 presented both English and Portuguese words in an identification test. The participant listened to one word at a time and identified whether it was English or Portuguese in a forced choice test. There were ten words from each language, examining dark /l/ perception in the context of all vowels in the study besides /aʊ/. There were two instances of /aʊ/, /eɪ/, /o/, and /u/, and four instances of /aɪ/, /ɛ/ and /i/, for a total of 20 items.

Exhibiting a pattern that by now must be familiar, Advanced performed poorly, Intermediate better, and Native Speakers best. Group mean error rates were Intermediate 20.08%; Advanced, 25.79%; and Native Speakers, 12.22%.

A one-way ANOVA performed on error rates by group indicates that at least two differ significantly (p = 0.012). Tukey's test finds the Intermediate mean error rate on Test 5 statistically equal to those of the other groups. The Native Speakers mean error rate, though, is significantly lower than that of the Advanced group.

Re-running ANOVA with only >99% responders supported the first ANOVA's result at a high level of confidence (p = 0.025), while Tukey's test no longer found a significant difference between the Intermediate group and the Advanced. Only a significant difference between the Advanced group and Native Speakers was confirmed.

4.4.6 Test 6 Error Rate vs. Class

Table 4.4.6 One-way ANOVA: Test 6 Error Rate vs. Class

Means		Principal	No NRs
	Intermediate	33.24%	33.18%
	Advanced	29.30%	27.60%
	Native Speakers	6.94%	6.94%
Analyses			
One-way ANOVA:	F (2, 45) = 17.76, p = 0.000, at least two groups are significantly different		
Tukey's test:	Intermediate and Advanced not significantly different Native Speakers erred significantly less than either Intermediate or Advanced		
Alternate ANOVA:	F (2, 32) = 17.09, p = 0.000, first finding supported		
Alt Tukey's test:	first findings supported		

Test 6 consisted of 16 English-only words ending in dark /l/ or /u/ in a forced choice identification test. The vowels here were /aʊ/ (4 tokens), /aɪ/ (2), /o/ (6) and /u/ (4). A high non-response rate of 75% led to the removal of one Advanced participant's test; none were removed from Intermediate.

The results of this test showed a dramatically strong contrast between the Brazilians and the Native Speakers. Mean total error rate for each group was Intermediate, 33.24%, Advanced, 29.30%; and Native Speakers, 6.94%. One-way ANOVA

confirmed this stark contrast at $p = 0.000$. Tukey's test showed no significant difference between the Intermediate and Advanced groups, and showed that the Native Speakers mean error was significantly, vastly lower than both groups of Brazilians.

Removing non-responders and retesting reduced the mean error rate of both Brazilian groups slightly, to 33.18% and 27.60%, but the ANOVA again registered a very strong p value of 0.000. Tukey's test results supported the first findings.

4.5 One unusual case in Test 1

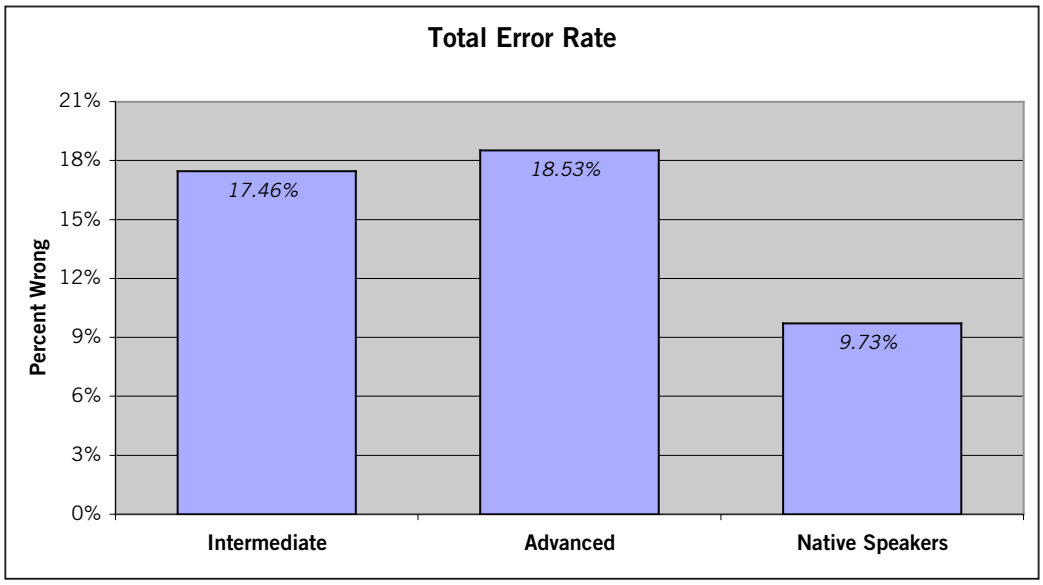
One participant in the Intermediate group, who shall be identified as IK, stood out from the rest for his unusual results. IK's error rate on Test 1, the first CDT, was more than 20 percentage points higher than anyone else's at 56.36% with only one non-response. His extreme error rate on Test 1 was identified as an outlier on a boxplot of Test 1 error rates in the software Minitab and with Grubb's test. To address IK's odd response here, the Total Error Rate analysis, all vowel context analyses, and the analysis of Test 1 were performed twice - once including his responses in Test 1 and once without them. For the Total Error Rate analysis and for the vowel-by-vowel analysis, all statistical conclusions were the same at similar levels of confidence.

Test 1's analysis without IK, however, contradicted the principal finding of no significant differences among the groups. Analysis without IK found that the Advanced and Native Speaker groups are significantly different, but that the Intermediate, with its mean between the two others, is not significantly different from either. These tertiary analyses are discussed at great length in Appendix 5.

4.6 Conclusions

4.6.1 Total Error Rate

Graph 4.6.1 Total Error Rates Compared



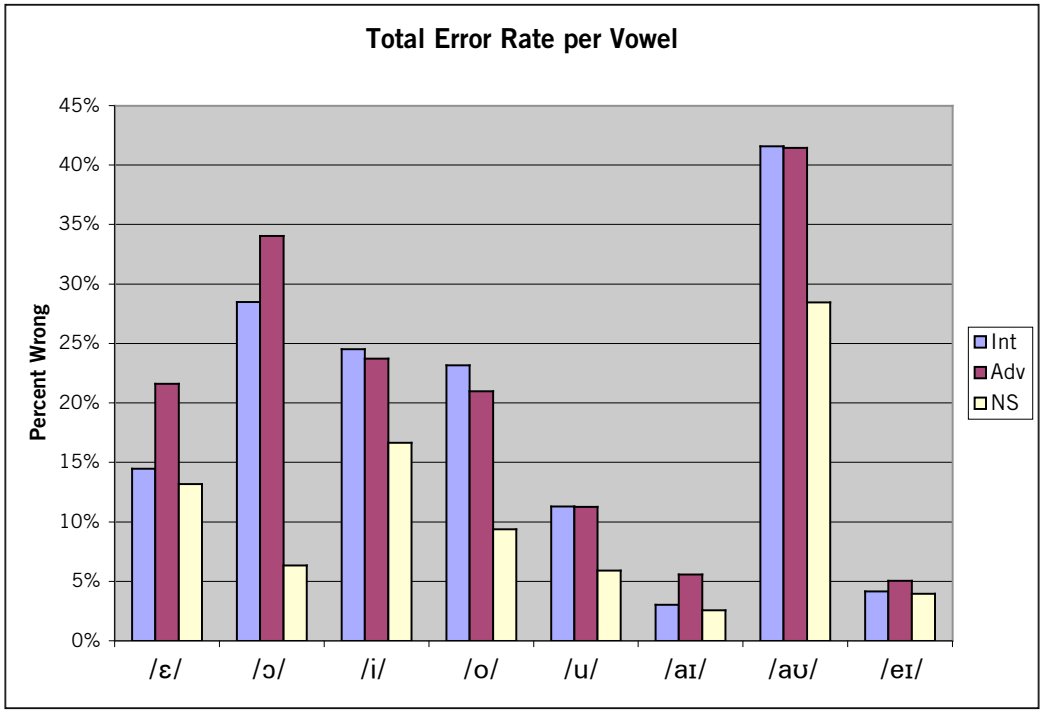
Test	Conclusion
TE vs. class: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv

In the principal analysis, Native Speakers' mean error rate for all tests combined and for every individual comparison by vowel and by test was lower than the mean error rate of either group of Brazilians. This difference was statistically significant for the overall results in both the principal analysis, with all responses, and in the secondary analysis with non-responders removed. Broadly speaking, this suggests that the Brazilians perceive English dark /l/ less often than native speakers. Later, when the results by vowel and by test are examined, it will become clear that a conclusion so plain will not fully accommodate the findings.

4.6.2 Total Error Rate per Vowel

In the graph below, statistical conclusions from the principal and secondary analysis are summarized. Where the two differed, the more conservative result was chosen as representative. The results of the less conservative test appear as footnotes.

Graph 4.6.2. Total Error Rate per Vowel



	/ɛ/	/ɔ/	/i/	/o/	/u/	/aɪ/	/aʊ/	/eɪ/
Intermediate	14.48%	28.49%	24.53%	23.18%	11.31%	3.04%	41.61%	4.16%
Advanced	21.63%	34.05%	23.75%	20.98%	11.29%	5.60%	41.46%	5.06%
Native Speakers	13.19%	**6.35%***	16.67%	**9.39%***	5.93%	2.59%	28.47%	3.97%

Test	Conclusion
/ɛ/ vs. class: 1-way ANOVA	no significant differences
/ɔ/ vs. class: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv
/i/ vs. class: Kruskal-Wallis	no significant differences
/o/ vs. class: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv
/u/ vs. class: One-way ANOVA	no significant differences†
/aɪ/ vs. class: 1-way ANOVA	no significant differences
/aʊ/ vs. class: 1-way ANOVA	no significant differences††
/eɪ/ vs. class: Kruskal-Wallis	no significant differences

* Significantly lower than Intermediate and Advanced.
† Principal analysis: Int and Adv not significantly different, NS < Int and Adv.
†† Secondary analysis: NS erred significantly less than Intermediate

To investigate research questions one and three, error rates by vowel context must be examined carefully. As can be quickly grasped by a glance at the graph, error rates varied widely depending on the vowel context. Some general consistencies are apparent. The two lowest error rates among all three groups were shared between the two fronting diphthongs /aɪ/ and /eɪ/. Neither error rate climbed above 6% for any of the groups in these contexts, and no significant differences were found among the groups in either the principal or secondary statistical analysis.

At least two possibilities exist to help explain the low error rates overall for these two diphthongs. First, they are both fronting diphthongs whose articulation ends at a high front position. The transition to the mid-back or high-back articulation of [w] or [ɬ] is a long one, and provides a large amount of additional phonetic information that participants could use to distinguish between sounds. Only the transition from [i] to [w] or [ɬ] would be longer, and then only by a small amount. But the much higher error rates among all three groups in the /i/ context suggest that something else is at work.

Quite possibly, it is the different syllabic treatment of the two diphthongs in English and Portuguese. Words like *paio* or *cheio* have two syllables in Portuguese, while the corresponding English *pile* and *shale* have only one syllable. The stress falls on the diphthong, and in the recordings used in these experiments, the stresses are quite clear. Furthermore, according to Azevedo, syllable final /l/ follows only monophthongal vowels in Portuguese (p. 68), potentially offering an extra clue to the Brazilian participants. Additionally, in these recordings, the speaker often exhibited a very slight /ə/ insertion in the transition to final /l/, a not uncommon occurrence in some dialects (Fujimura and Erickson, p. 100-101).

The third lowest error rate for Brazilians and Native Speakers was observed for the context /u/. As /u/ is one of the vowels most frequently compared to final /l/, it is somewhat surprising that error rates in this context were so low. Despite many articulatory differences described by Azevedo (p. 66), formant frequencies for General American /u/ and Brazilian Portuguese tonic /u/ are quite similar. For GA /u/, Ladefoged (2001, p. 172) reports F1 and F2 as 310Hz and 870Hz. For BP tonic /u/, two studies by Fails and Clegg (1992, p. report F1 at 315–318Hz and F2 between 832Hz–896Hz. Perhaps the amount of lip rounding that accompanies /u/ is quite significant phonetically here, and helps make clear the difference between the final segments.

In the primary analysis, even though all groups' error rates were low, Native Speakers mistakenly identified tokens significantly less than Brazilians, whose error rates differed by a trivial two hundredths of one percent. The secondary analysis lowered the Brazilians' mean error rates enough for one-way ANOVA to find no difference among the groups. To remain conservative, the conclusion must be, then, that there are no significant differences.

As with the diphthongs /aɪ/ and /eɪ/, phonetic differences in the realization of /u/ could have contributed to the participants' low error rates. Azevedo (p. 66) and Avery and Ehrlich (1992, p. 33) point out that English /u/ often features a slight diphthongization. This is evident in the experiment's recordings in words like *poo* and *foo*. Also, the words' duration is almost clipped, as are the durations of the Portuguese words *pul* and *ful*, in contrast to the more relaxed pronunciation of English *fool* and *pool* that the speaker uses. Also, here again the final /l/ in English is preceded by a

barely noticeable /ə/. These factors increased the contrasts between the tokens, and perhaps made the distinctions easier to perceive for Brazilian participants.

The only other context with across the board similarities in rank was the diphthong /aʊ/, which had the highest error level for all three groups of participants. For Native Speakers it was the worst by far, with almost twice the errors of /ɛ/. The primary analysis found no statistically significant differences among the groups, while the secondary found Native Speakers to have erred significantly less than only the Advanced group, whose error rate climbed 4 points without non-responders. Considering the nearly insignificant *p* level in the first ANOVA, to remain conservative the conclusion must be that there are no differences.

As mentioned earlier, the vowel context /aʊ/ is peculiar among the contexts studied here. Contrasts were examined for /aʊ/ primarily between the English-only vow and vowel, which appeared in 14 of 16 instances. In the other two instances, *pow*, /paʊ/, was contrasted with *pal*, /pal/, (according to Merriam-Webster, /pæl/ according to the OED). These contrasts are not precisely comparable to each other. The word *vowel* features /l/ after the diphthong, rather than replacing a final [w], [u] or [ʊ] with [ɬ]. There may also be a /ə/ before the final /l/ in some pronunciations, as it is in two of the tokens spoken here. The word *pal* substitutes [l] for the [ʊ] of the diphthong /aʊ/ in *pow*, but the preceding vowel is not necessarily /a/, depending on the dialect. In this experiment's speaker's pronunciation, the vowel in pal varies, but is very similar to his vowel in pow. These several caveats would seem to suggest the presence of more phonetic information that could be used to distinguish the tokens from one another, and thus make less likely that any differences noticed were due solely to the presence or absence of /l/. But, in fact, the error rates for /aʊ/ were very high for all groups, suggesting instead that the /l/

was particularly difficult to distinguish in this context. Given the peculiarities of this vowel context, this can tentatively be attributed to the great phonetic similarity between /ʊ/ and dark /l/, especially considering that this diphthong makes its transition to a mid-back articulation before any further transition to dark /l/.

For the mid-front and high-front English-Portuguese vowel contexts /ɛ/ and /i/, no significant differences were found in any analysis. The middling error rates for Brazilians came as a surprise, especially considering the excellent error rates for the two fronting diphthongs and the changes in articulation from front to back. Even more surprisingly, it was on these two vowel contexts that Native Speakers performed second and third worst.

The relatively long transition from front to back provides additional phonetic information, but, for Brazilians, an apparently more important cue was the duration of the contrasted words in Tests 1 and 3. Careful examination of the test items containing /i/ and /ɛ/ on Tests 1 and 3 found that when the temporal differences between the tokens were highest, the error rates among Brazilians were lowest, and vice versa. Temporal differences did not appear to affect Native Speakers responses very much. This is most dramatically seen for /i/ in items 22 and 27 in Test 3, and for /ɛ/ in item 29 in Test 1, where the length of the tokens was extremely similar. All but one of the Brazilians responded incorrectly to 22 and 27 (/i/) on Test 3. For item 29 on Test 1 (/ɛ/), half the Brazilians responded incorrectly. For both of those items, there were no Native Speaker errors. While it is impossible to say conclusively with so many variations, it would seem that when there are fewer differences between tokens so that the phonetic contrast is tightly limited to only the final segment, Brazilians fail to distinguish English final /l/.

For the monophthong /o/, which was examined in all six tests, Native Speakers were found to have made significantly fewer mistakes than either group of Brazilians in both the primary and secondary analysis. Here, similarity between the mid-back /o/ and final /l/, and thus fewer differences in the transition from one to the other, could have led to higher errors for the Brazilians. On the other hand, the slight diphthongization of English /o/ could have provided an additional clue to distinguish among or between tokens on the tests of English and Portuguese.

Concerning /ɔ/, which appeared in the tests of English-Portuguese contrasts, the differences among the groups are most stark. Native Speakers identified dark /l/ correctly significantly more often than Brazilians, and at a much lower error rate. The monophthong /ɔ/ is a mid-height back vowel, and though it is not cited as a similar sound in any texts consulted, corresponds very closely to dark /l/ phonetically, at least according to some measurements. Ladefoged (2001, p. 172) shows American English /ɔ/ to have first and second formants of 590 and 880 Hz, and while dark /l/ is reported by Recasens (1996), Lehiste (1964), and Moore (2006) to have F1 between 300 and 551 and F2 to be between 770 and 1000. Two other back vowels, /ʊ/ and /u/, are reported by Ladefoged as follows: /ʊ/ - F1, 450 Hz, F2, 1030 Hz; /u/ - F1, 310 Hz, F2, 870 Hz. Only /u/ could possibly be said to be more similar to dark /l/ than /ɔ/ based on the first two formants.

So why would Brazilians have erred so much more on /ɔ/ than on /u/? Perhaps the insertion of /ə/ before /l/ in English /u/ words could have provided enough extra information to make identification easier for Brazilians. If not, lip rounding for /u/ provides even more additional phonetic information. No /ə/ insertion after /ɔ/ is apparent and lip rounding is minimal. There is also very little transition between the

vowel and the final segment. An additional contributing factor could be that the words used for /ɔ/ might as well have been nonsense words in both languages: *kol* edited from *skol* in Portuguese, and *cawl,* a kind of Welsh soup. Uncommon or nonsense words perhaps reduce the possibility of lexical interference, and permit a more direct experience of phonetic information. The similarity of the vowels could play a part as well. Azevedo notes that Portuguese [ɔ] is shorter and the tongue is positioned higher than "is required" for English [ɔ]. He concludes that aside from these details, English [ɔ] is "as good an approximation to Portuguese [ɔ] as any" (p. 64).

With so little to distract from the final segment, unlike with /o/ or /u/, this comparison provides what may be the best evidence that Brazilians perceive English dark /l/ poorly, as it best isolates the distinction in question.

4.6.3 Discussion by data pattern

As noted earlier, the two groups of Brazilians did not significantly differ in their responses overall, or on any of the comparisons by vowel context or by test. Nevertheless, despite the lack of statistical significance, it should be pointed out that in half the vowel contexts and on two thirds of the tests, the Intermediate group erred less than the Advanced group. In some cases, once in the principal analysis and twice in the secondary, because of the low error rates of the Intermediate group, the Native Speakers erred significantly less than only the Advanced group. In the cases of /ɛ/, /aɪ/, and /eɪ/, the Intermediate group actually outperformed the Native Speakers in the secondary analysis.

No obvious explanations were found. Despite that no broad correlation was found earlier, the groups were examined to check whether more Intermediate students had

spent significant time in English-speaking countries than Advanced. Rather, just the opposite was true – exactly twice the number of students in the Advanced group had lived for three or more months in an English-speaking country, and twice the number had visited for a short time. As touched on earlier, participants were not limited by age for this study. But because many studies do limit participants by age, and because the Advanced group had a greater number of people over thirty, including two in their sixties, another series of ANOVA and Kruskal-Wallis tests were performed on the vowel responses with only participants aged 18-30 (see Appendix 6). Statistical results all support the same conclusions as the original tests except for /u/, for which Native Speakers erred significantly less than both groups of Brazilians. This is the same result as the primary analysis, but not the secondary.

If not age, what else could explain this peculiar result? Due to the dual language nature of half the tests, it is possible that linguistic factors besides the final phoneme are the culprit. As discussed with respect to the vowel contexts, there are many additional phonetic clues present in the recordings that could aid in their distinction from each other. It also could be that the Intermediate students were better than Native Speakers at recognizing Portuguese tokens. And, of course, it is possible that the Intermediate group's low error rates (or the Advanced group's elevated error rates) represented nothing more exotic than a chance occurrence.

It is even conceivable that perception could get *worse* with more exposure. U-shaped development—from "good" to "bad" and back again—is common for grammatical structures in both first language acquisition (Ellis, p. 77) and second language acquisition (p. 303). Whether it is common in phonological development is

less clear[7]. Flege, Bohn, and Jang (1997) concluded that more exposure corresponded to better perception in a study of non-native speakers of English from a variety of countries. On the other hand, Leather and James (1996, p. 289) suggest that new sounds similar to L1 sounds can actually "regress" to make way for L2 sounds that are less familiar.

With regard to theory, consider the SLM's second and fifth hypotheses (Flege, 1995, p. 239):

> H2: A new phonetic category can be established for an L2 sound that differs phonetically from the closest L1 sound if bilinguals discern at least some of the phonetic differences between the L1 and L2 sounds.
>
> H5 states in part: Category formation for an L2 sound may be blocked by the mechanism of equivalence classification.

Other authors offer similar ideas. Kuhl says "foreign language units that are similar to a native-language category are particularly difficult to perceive as different from the native-language sound" and adds that L2 phones which are too similar to L1 phones will be assimilated into L1 categories (1993, p. 131). In contexts with little phonetic information besides the target contrast, such as /ɔ/, Flege's and Kuhl's statements offer plausible support for the findings.

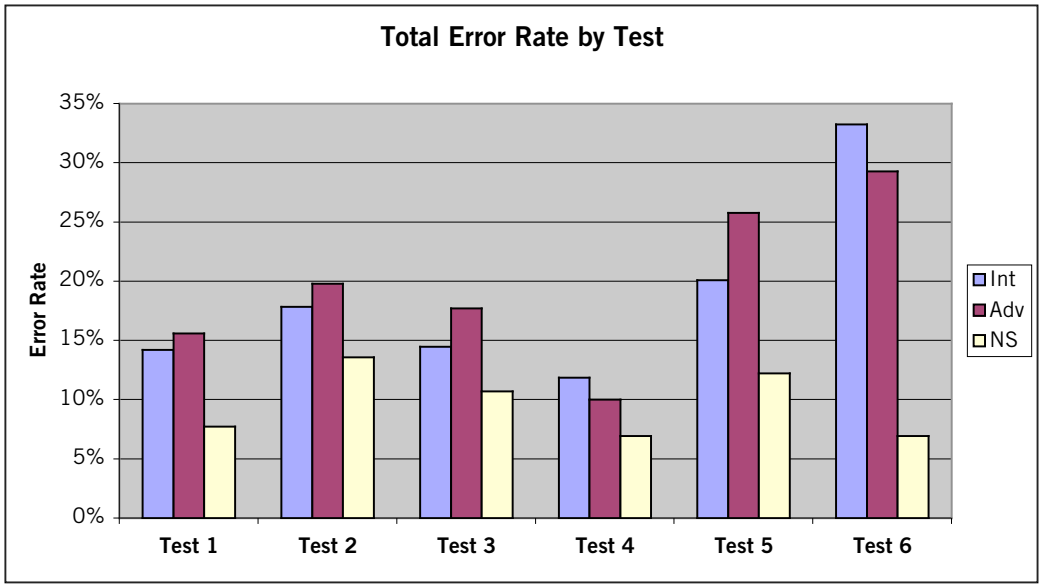
But the results of this experiment lead to the conclusion that in some vowel contexts even native speakers do not perceive a difference between word-final /l/ and word final [u] or [w] well. For this reason, we must consider the likelihood, at least in some contexts, that not only are the phonetic differences insufficient to create a new category, they are also insufficient for Native Speakers to discern.

[7] Anecdotally, consider the case of Brazilians learning to suppress word final epenthesis. For a word like *cookie*, an intermediate stage pronunciation may involve oversuppression of the final vowel, resulting in a pronunciation more like *cook*. Advanced learners learn to correctly pronounce both words.

4.6.4 Total Error Rate by Test Summary

The graph below summarizes the statistical conclusions from a comparison of the principal and secondary analysis. Where the two analyses differed, the more conservative result was chosen as representative. The results of the less conservative test can be found footnoted beneath the summaries.

Graph 4.6.4 Total Error Rate by Test



	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Intermediate	14.20%	17.83%	14.46%	11.88%	20.08%	33.24%
Advanced	15.61%	19.79%	17.72%	10.02%	25.79%	29.30%
Native Speakers	7.74%	13.58%	**10.71%****	6.94%	**12.22%****	**6.94%***

Test 1: Kruskal-Wallis	no significant differences
Test 2: 1-way ANOVA	no significant differences
Test 3: Kruskal-Wallis	Int not significantly different from either Adv or NS, NS < Adv
Test 4: 1-way ANOVA	no significant differences
Test 5: 1-way ANOVA	Int not significantly different from either Adv or NS, NS < Adv†
Test 6: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv

* Significantly lower than Intermediate and Advanced. ** Significantly lower than Advanced
† Principal analysis: Int and Adv not significantly different, NS < Int and Adv

As reported earlier, one-way ANOVAs and Kruskal-Wallis tests were performed to compare all three groups of participants on each of the six tests. On Test 1, a CDT of English and Portuguese contrasts, and on Tests 2 (CDT) and 4 (same-different), of English-only contrasts, no significant differences in error rate were found among the groups on either the principal or secondary analysis.

On Test 3, a same-different test of English and Portuguese, Native Speakers' error rate was significantly lower than only the Advanced group, while the Intermediate error rate was not found to differ from either of the other groups. On Test 5, the principal analysis found Native Speakers to have erred significantly less than both other groups, while the secondary analysis found them only to have outscored the Advanced group. The conservative conclusion, therefore, is that the Native Speakers identified contrasts more accurately than only the Advanced group.

Only on Test 6, an identification test of English-only final back rounded vowels and final /l/, were Native Speaker error rates found to be lower than both groups of Brazilians on both analyses. Native Speakers error rates were lowest on Test 6 and, curiously, Brazilian error rates were highest. This would seem to indicate only that Brazilians' perception of the English sounds in isolation is poor.

In contrast, results on Test 4, which presented two English words in quick succession, suggest that Brazilians have little trouble distinguishing a contrast between the sounds of English word-final /l/ and word-final back rounded vowels when the sounds are heard close together. Presumably, this would extend to even better identification within the flow of speech, when other lexical and phonetic cues are available.

Chapter 5 – Correlation: Results and Analysis

5. Correlation Exploration

The fifth research question concerns possible correlations between demographic characteristics of the participants and their combined total error rates on the 6 tests. To do this, a variety of statistical procedures were performed, each selected for its appropriateness to the data to be analyzed. The data from the detailed demographic questionnaire was codified to allow for statistical analysis. For the most part, only the Total Error Rates of the Brazilian groups were examined for correlations with demographic data. Where data from Native Speakers was also present, for items such as sex and age, they were included in the correlation test. For one test of Native Speakers only, the respondents were subdivided into British and American groups. Questionnaire results which were examined for correlations appear in Appendices 11, 12 and 13.

After a brief introduction, all results are presented as charts, with the character ⧫ in the last column before any results with *p* values below or near the alpha level of 0.05. Any interesting correlations will be discussed below the charts.

5.1 Correlations with all participants

Basic information about all respondents was compared with Total Error Rates to examine for correlations using the point-biserial correlation formula or Pearson's product-moment correlation. Because the Total Error Rates of Native Speakers were generally lower than those of the student groups, the results were re-examined without the Native Speakers. For the variables examined – sex and age – no results were remotely close to significant. Further analysis with listwise deletion and with outliers

removed was also performed, but all conclusions were the same. These results can be seen in Appendix 7.

Often experimental groups are homogenized by age. In this study, the decision not to was based on the SLM's first postulate, that "the mechanisms and processes used in learning the L1 system...remain intact over the life span, and can be applied to L2 learning" (Flege, 1995, p.239): As all students were at the same level in a homogenous program, it was not felt necessary to limit the group by age.

Table 5.1. Correlations: universal data

Variable	Measurement	Test type	Result
All Groups - Sex	male/female	point-biserial	$r = -0.087$, $p = 0.533$
All Groups - Age	numerical age	Pearson's r	$r = -0.020$, $p = 0.891$
Brazilians only - Sex	male/female	point-biserial	$r = -0.087$, $p = 0.595$
Brazilians only - Age	numerical age	Pearson's r	$r = 0.080$, $p = 0.625$

5.2 Correlations with Brazilians only

The extensive questionnaire given to Brazilian participants allowed a large number of interesting factors to be examined for correlations with Total Error Rate. The bulk of the questions analyzed for correlations concerned geographical factors or travel and language experience.

All tests were performed three times. The principal analysis was performed with Total Error Rates for both groups of 20 Brazilian participants, which were calculated by handling missing data through pairwise deletion. The second analysis, as with the earlier tests, was conducted only on the Total Error Rates of those Brazilian participants who responded to all items on the test, which left just 11 per group. The second analysis was performed for two reasons. First, there is no consensus among statisticians on a best method for dealing with missing data. Second, if a correlation found in the analysis

with pairwise deletion was also found using listwise deletion, a conclusion could be stated with great confidence, especially since the number of people per group drops so steeply in the second analysis.

Finally, a third analysis was conducted on the Total Error Rates of all Brazilian participants *minus* one outlier from each group, since outliers can have a pronounced effect on correlation coefficients. The outliers were identified as mild outliers on the box plots drawn for each group separately in Minitab, but Grubb's test did not agree. Nevertheless, for curiosity's sake, the analysis was performed again. The two participants with Total Error Rates identified as outliers did not respond to all items, so they were excluded from the second analysis by default.

In the charts, some variable names and measurements are self-evident. Notes are below for the remaining variables. Discussion will follow the charts concerning the significant or near significant results marked in the chart's last column with ⧫. Only significant or near significant correlations are shown for the second and third analyses. Charts with all results are in Appendix 8.

Accent heard when growing up. "Other" included "Arabic of my father" in one case and "German of relatives" in all others.

Teacher's evaluation of student. This item was not on the questionnaire, but rather reflects the researcher's opinion of the student's spoken English relative to his or her class level. The measurements were "below average for level, average for level, above average for level."

English-speaking country experience. The measurement "little" corresponds to trips and stays of less than one month. "Extensive" indicates greater than three contiguous months living in an English-speaking country.

Other foreign country experience? None reported was in a non-English-speaking country whose language includes dark /l/.

Speak other languages? This question was asked both to gauge whether general language knowledge might have an effect on performance and to find whether anyone spoke a language with dark /l/. One student reported Arabic, acquired

naturally from Lebanese father and relatives. This student did not perform particularly well. Even if he had, this would only have been a curiosity that would need further study.

Other native English-speaking teacher? If participants responded "yes," they were asked to tell their other teacher's country of origin. Responses included US, England, Australia and Scotland.

Contact with Continental Portuguese? Responses generally described a very low level of contact. Only one student had had a good deal of exposure, by living with a Portuguese roommate in London. Here again, the student did not perform too well.

Contact with older Riograndenses? The questionnaire specified Riograndenses older than 60 years and asked for details if the answer was yes. In all cases but one the exposure came from relatives.

Contact with NS (Native Speakers) of English. This question refers to contact outside the classroom. Positive responses indicated either sporadic contact or regular contact.

Table 5.2a Correlations: primary analysis

Variable	Measurement	Test type	Result
Place of origin	region (S, SE, CW, NE)	ANOVA	$p = 0.831$
Accent heard when growing up	region (S, SE, other)	ANOVA	$p = 0.407$
Self-reported accent	region (S, SE, indeterminate)	ANOVA	$p = 0.705$
Teacher's evaluation of student	above avg, avg, below avg	Pearson's r	$r = 0.262$, $p = 0.102$
English-speaking country exp.	none, little, extensive	Pearson's r	$r = 0.218$, $p = 0.176$
Other foreign country experience	yes/no	point-biserial	$r = 0.125$, $p = 0.477$
Native speaker audio in class	none, little, much	Pearson's r	$r = -0.142$, $p = 0.396$
Speak other languages?	yes/no	point-biserial	$r = -0.101$, $p = 0.539$
Other native Eng-speaking teacher?	yes/no	point-biserial	◆ $r = 0.298$, $p = 0.066$
Contact w/ Continental Portuguese?	none, little, much	Pearson's r	$r = 0.009$, $p = 0.956$
Contact with older Riograndenses?	yes/no	point-biserial	◆ $r = -0.308$, $p = 0.056$
Contact with NS of English	little outside class, regular	point-biserial	$r = 0.084$, $p = 0.623$

Table 5.2b Correlations: no non-responders

Variable	Measurement	Test type	Result
Speak other languages?	yes/no	point-biserial	◆ $r = -0.372$, $p = 0.061$
Other native Eng-speaking teacher?	yes/no	point-biserial	$r = 0.308$, $p = 0.126$
Contact with older Riograndenses?	yes/no	point-biserial	◆ $r = -0.377$, $p = 0.057$

Table 5.2c Correlations: no outliers

Variable	Measurement	Test type	Result
Speak other languages?	yes/no	point-biserial	$r = -0.235$, $p = 0.162$
Other native Eng-speaking teacher?	yes/no	point-biserial	◆ $r = 0.342$, $p = 0.038$
Contact with older Riograndenses?	yes/no	point-biserial	◆ $r = -0.416$, $p = 0.010$

In the principal analysis, no *p* values descend below 0.05, but two are close enough to merit discussion. Regarding *Other native-speaking teacher?* vs. *Total Error Rate*, a mild positive correlation of 0.298 with a nearly significant *p* value of 0.066 was found. *Yes* was codified as *1*, and *no* as 0, thus, a positive correlation here means that those who had *not* studied under another native speaker had lower Total Error Rates. Regarding *Much contact with older Riograndenses?* vs. *Total Error Rate,* a mild correlation of -0.308 with a nearly significant *p* value of 0.056 was found. Again, *0* and *1* signified *no* and *yes*. Here, though, the correlation, because it is negative, indicates that those who reported significant exposure to older Riograndenses had lower Total Error Rates. This is intriguing given the assertion in many descriptions of Brazilian phonology that the Riograndense dialect contains or contained dark /l/.

The second analysis finds a very similar correlation coefficient for *Much contact with older Riograndenses?* at a similar *p* value (r = -.0377, p = 0.057), and thus confirms the first findings. Here, though, the *Other native English-speaking teacher?* confidence level weakens to p = 0.126. In the third analysis, with outliers removed, the correlations for both *Other native English-speaking teacher* and *Contact with older Riograndenses?* are stronger than in the first analysis and are significant at r = 0.342, p = 0.038 and r = -0.416, p = 0.010 respectively. The second analysis also found a significant weak negative correlation between *speak other languages?* and Total Error Rate, but neither of the other analyses found a significant correlation.

No clear conclusion can come from these analyses, unfortunately, except that further study is needed. Since it is impossible to know (in this study) whether students' previous native speaker teachers from England, the US or Australia spoke a regional dialect that vocalizes final /l/, a future experiment comparing students of only native speakers with known accents would perhaps be more likely to show whether exposure

to English dark /l/ helps students recognize it. But the possible correlation between *Much contact with older Riograndenses?* and Total Error Rate is very intriguing. A study, say, comparing a large number of students controlled for consistent exposure to older Riograndenses to a group from other regions might more accurately find whether a correlation indeed exists.

5.3 Correlations with Native Speakers only

Native Speakers were compared by their country of origin. The results appear below.

Table 5.3 Correlations: Native Speakers only

Variable	Measurement	Test type	Result
Place of origin	US/UK	point-biserial	$r = 0.632$, $p = 0.068$

There was a fairly strong correlation of 0.632 reported by the point-biserial correlation formula. Because *US* was coded as *0* and *UK* as *1* to run the test, this would mean that the US speakers responded more accurately than the UK speakers if the confidence level was at or below the preset alpha level of 0.05. But let us consider what *p* signifies, which is "the probability of obtaining a result by chance alone." While it cannot be said with great confidence that a correlation exists here, a retest with a larger group of native speakers from both the US and UK would be interesting to carry out.

What would such a correlation mean? It could mean that American dark /l/ is such a subtle sound that it is difficult to detect even by Native Speakers of other English dialects. Or perhaps the widely noted weakening of the dark /l/ to a vocalized back vowel in a number of Southern English accents is to blame. The experimenter found that all speakers spoke with dark /l/, but perhaps it is a subtler sound than he realizes.

Chapter 6 – Conclusion

6.1 Major Findings

Let us now address the research questions posed in Chapter Three. And let us begin where an unambiguous answer can be offered: with research question four.

Research question four purposed to investigate whether Advanced students would perceive dark /l/ more accurately than Intermediate students. Here, the overall results were somewhat unexpected, and the answer is that they categorically do not. For overall error rates, for error rates by vowel, and for error rates by test, no statistically significant differences were ever found between the two groups of Brazilians. In fact, though it was not statistically significant, the Advanced group had a *higher* overall error rate than the Intermediate group in the comparison of total error rates. This pattern was also found in more than half the analyses by vowel, and 2/3 of the analyses by test, but, as in the overall results, it was never statistically significant. While a statistically significant difference between the groups would have been surprising, at least some previous research suggests that where a difference is perceived, a group with more exposure to the target language would perceive more accurately.

Research question one concerned whether native speakers of English and Intermediate and Advanced Brazilian learners of English all have difficulty perceiving a difference between English dark /l/ and various back vowels and diphthongs. It appears that all groups do, at least in some settings, although generally the Native Speakers had less difficulty than the Brazilians. Depending on the vowel context, the error rates for all three groups varied greatly. All groups' best results were on the same three contexts and were so low on the two fronting diphthong contexts that it cannot be said that they had any real difficulty there. Similarly, all groups' worst context was the same; it can be

stated unequivocally that all groups had pronounced difficulty distinguishing between final phones after /aʊ/. In only two contexts, Native Speakers appeared to perceive fairly well when Brazilians had difficulties. In the remaining contexts, error rates for all three groups varied together. If Native Speakers always perceived dark /l/ distinctly, their error rates would have been low regardless of the context.

Research question two sought to learn whether Brazilians perceive differences less frequently than Native Speakers, since dark /l/ does not exist in the great majority of modern Brazilian Portuguese dialects. Overall error rates of Native Speakers were significantly lower than those of both groups of Brazilians, but not so low as might be expected. Flege (ms) suggests that an error rate of 3% is reasonable to expect for difference trials on a CDT investigating vowel contrasts. For Native Speakers, error rates here were almost 7% on the CDT of English and Portuguese, and close to 14% on the CDT of English only. Some other investigations of consonant sounds using a CDT have found more native difficulties than Flege predicted as well. Aoyama (2003), Kluge (2004), and Reis (2006) all showed error rates for native speakers higher than Flege's prediction and variously attributed the results to perceptual similarity or to flaws in test design.

The third research question aimed to discover whether some phones before dark /l/ and /w/ make these word-final distinctions harder to discern than others. All participants made perception errors that varied with the vowel context, although it is not possible to attribute the difficulty to spectral clues alone. While raw error rates were mostly lower for Native Speakers than for Brazilians, they were conclusively *significantly* lower only on two contexts, with a third context suggested to be lower by only one analysis. Thus, it is possible to say confidently that the Brazilians perceived the final-phone differences less frequently only after the vowels /ɔ/ and /o/. The /ɔ/ context stands out among the

other tests for the great difference between the Brazilian and Native Speaker error rates and perhaps provides the best evidence that dark /l/ is a difficult sound for Brazilians.

That Brazilians showed greater facility at recognizing differences in many contexts does not necessarily mean that they perceived differences between the final phones, however. Other clues, such as stress, prosody, partial diphthongization of English vowels, and occasional insertion of /ə/ before /l/ could have made distinctions between tokens clearer.

Research question five aimed to investigate correlations, and though no correlations were found to be statistically significant in the primary or secondary analysis, several results were nearly so and could merit further study. Most intriguingly, lower error rates among Brazilians nearly correlated with contact with elderly Riograndenses, and did correlate when a third analysis with two outliers removed was conducted. It was also interesting to find that American English speakers possibly perceive dark /l/ more accurately than British speakers.

6.2 Pedagogical Implications

The teacher with an awareness of phonological research is better able to sensitively teach pronunciation. With an ear towards common difficulties in perception and production, reasonable performance expectations can be set for students, and they can be taught to create reasonable expectations for themselves. With phonological knowledge, teachers are better able to understand the language they are teaching and are more capable of passing that knowledge to students. And by teaching not only *of* the language but *about* it, new doors to learning can be opened.

Where differences in an L2 cannot be perceived initially, instruction can direct students' attention and perhaps speed the process of acquisition. So if Brazilians do

poorly discern the English phone [ɬ] in word final position as suggested by this experiment's results, they could be explicitly instructed in all aspects of its articulation to help them identify it. By showing some vowel contexts which may make Brazilians' (and Native Speakers') discernment of dark /l/ more difficult, teachers could focus attention where it would be most helpful. Especially in the case of /o/, which was shown to be significantly more difficult for Brazilians than for Native Speakers, common word pairs, among them *toe/toll, row/roll, bow/bowl* and *hoe/hole* differ only in the presence or absence of a final dark /l/. Contexts in which they could be confused can easily be imagined. The results of this study indicate possible additional phonetic clues that could be pointed out to help in the identification of dark /l/.

Of course, not all students are concerned with attaining native-like pronunciation. It must be acknowledged that the potential for embarrassment is not nearly as high as for the /i/ vs /ɪ/ contrast, which affords two potentially very offensive mistakes with the words *beach* and *sheet*. And, we must consider that Native Speakers themselves had clear difficulty with perception of word final /l/ in this experiment, even though they were explicitly told the subject of the study. Realistically, instruction in the particulars of dark /l/'s production will probably be restricted to those students for whom native-like production is very important. Thus, this study is perhaps more relevant to theory of second language acquisition than to pedagogy.

6.3 Limits of the study and suggestions for further research.

One obvious, and large, limitation was the use of a single speaker to record all utterances heard by the participants. The speaker's idiosyncrasies may have affected the results, especially on the English only section. His pronunciation of *pool,* for instance, reflected a shift in the vowel to /ə/ before the /l/ that perhaps made the distinction

between *poo* and *pool* easier to make. More speakers would allow for a broader picture of the character of the final phonemes in English and Portuguese.

A more general problem that would affect many speakers of English is the different temporal characteristics of contrasts like *tow/toll* and *poo/pool*. In both cases, the shorter word is pronounced more quickly, giving listeners an additional clue they can use to distinguish differences between words. Temporal and intonation characteristics also affect the contrasts between Portuguese and English words in the Portuguese/English section in contrasts like *shale/cheio*. This became especially clear when editing the sounds. The speaker's tone of voice was lower in Portuguese, and the speed with which words were spoken was almost always faster. Varying the speaker would perhaps have made these differences less noticeable. If this type of variation of the CDT is used in the future, three "true" bilinguals should be used to ensure that participants are not listening to differences in the speaker or recording, but are paying attention to the sounds of speech at a more abstract level, as long as pronunciations are otherwise similar.

Because of the range of potential problems in using two languages in CDT, difference and identification tests exposed by this experiment, it seems it might be better to compare the contrast between final /l/ and /w/ by using more English words in a future experiment, especially given the stark performance contrast between native speakers and Brazilians in Test 6. Also, because of the temporal clue in many contrasts, speakers could be instructed to pronounce the same word (in English) in two ways: normally and with a vocalized /l/. Because this is a common speech error made by children and often imitated by adults, consistent production would probably not be difficult to acquire from the speakers. Further, it would be easy to describe to them how to produce the alternate sound. This approach would necessarily be limited to minimal

pairs that do not actually exist in English, however, for example /hiw/ contrasted with /hil/. Another way to remove temporal and intonational influence would be to synthesize tokens. Minimizing some potential aural distractors with speech synthesis could only come at the cost of naturalness, however. Much further refinement of this experiment must be done before attempting it again, to eliminate even more irrelevant variation, and to focus solely on the phonemes whose perception is to be investigated.

Despite the perhaps excessive extent to which the results of the current study were analyzed statistically, further investigation of correlations would be interesting. By using word frequency lists or textbook vocabularies to divide test tokens into "common words" and "uncommon words" an effect of lexical familiarity could perhaps be explored. Would words that students are more likely to know be easier to identify as ending in /l/ based on recalled orthography? Conversely, any lexical familiarity effect could be eliminated by using only nonsense words.

Nonsense words would also make test design easier. The words chosen for this experiment were limited to those that had phonetic analogues in English and Portuguese both, such as the pair *fail/feio.* This led to an unequal number of tokens to analyze for the eight different vowel contexts studied, from 4 tokens for /a/ to 32 tokens for /o/. Because of the desire to use natural phonetic complements in the two languages, there was no attempt to control for phonetic environment before the vowel that preceded the final /l/ or /w/ in the tokens recorded. So, for instance, one pair, *feel/fio*, begins with a labiodental voiceless fricative, while *goal/gol* begins with a voiced velar consonant and thus is articulated on the opposite side of the mouth from /f/. Although most words in this study are monosyllabic, in some difficult cases a two-syllable word was used.

Many other aspects of the results and of the design could be developed further. Additional analysis of English/Portuguese versus English only tests would be valuable

to investigate the effect of language on the results. Such investigation should have been planned based on the unusual bilingual nature of this study. A comparison of results based on whether token words were common or not might show the effect of lexical interference. Future experiments could be conducted with synthesized tokens instead of recordings to eliminate extraneous phonetic information where phonetically possible within the constraints of natural pronunciation.

And, finally, the intriguing possibility of a correlation between overall performance and exposure to elderly Riograndenses was a delightful discovery. Only further study can determine whether such a relationship exists.

References

Allison, P. D. (2002). *Missing Data.* London: Sage Publications, Ltd.

Andrade, A. (1999). On /l/ velarization in European Portuguese. In J. Ohala, Y. Hasegawa, M. Ohala, D. Granville & A. Bailey (eds.), *Proceedings of the 14th International Congress of Phonetic Sciences*, San Francisco, pp. 543-546.

Aoyama, K. (2003). Perception of syllable-initial and syllable-final nasals in English by Korean and Japanese speakers. *Second Language Research, 19*(3), 251-265.

Aoyama, K., Flege, J. E., Guion, S. G., Akahane-Yamada, R., & Yamada, T. (2004). Perceived phonetic dissimilarity and l2 speech learning: the case of japanese /r/ and english /l/ and /r/, *Journal of Phonetics, 32*(2), 233-250.

Avery, P., & Ehrlich, S. (1992). *Teaching American English pronunciation*. Oxford: Oxford University Press.

Azevedo, M. M. (1981). *A contrastive phonology of Portuguese and English*. Washington, DDC.: Georgetown University Press.

Ball, M. J., & Müller, N. (2005). *Phonetics for communication disorders.* Mahwah, NJ: Lawrence Erlbaum Associates.

Baptista, B. O. & Silva Filho, J. L. A. da (1997) The influence of markedness and syllable contact on the production of English final consonants by EFL learners. In J. Leather & A. James (Eds.), *New Sounds 97: Proceedings of the Third International Symposium on the Acquisition of Second-language Speech* (pp. 26-34). Klagenfurt, AUS: University of Klagenfurt.

Baptista, B. O. (2001). Frequent Pronunciation Errors of Brazilian Learners of English. In M. B. M. Fortkamp & R. P. Xavier (Eds.), *EFL teaching and learning in brazil: Theory & practice* (p. 223-230). Florianópolis: Insular.

Baratieri, J. P. (2006) *Production of /l/ in the English coda by EFL learners - an acoustic-articulatory analysis.* Unpublished master's thesis. Florianópolis, Brazil: Universidade Federal de Santa Catarina.

Best, C. T. (1995). A direct realist view of cross-language speech perception. In W. Strange (Ed.), *Speech perception and linguistic experience: Theoretical and methodological issues* (pp. 171-203). Baltimore, MD: York Press.

Bettoni-Techio, M. (2005) *Production of final alveolar stops in Brazilian Portuguese/English interphonology.* Unpublished M.A. thesis. Florianópolis, Brazil: UFSC.

Bladon, A. & Al-Bamerni, A. (1976). Coarticulation resistance in English /l/. *Journal of Phonetics*, *4*, 137-150.

Brown, J. D. (1988). *Understanding Research in Second Language Learning: A Teacher's Guide to Statistics and Research Design.* Cambridge: Cambridge University Press.

Carlisle, R. S. (1994). Markedness and environment as internal constraints on the variability of interlanguage phonology. In M. Yavas (Ed.), *First and second language phonology* (pp. 233-249). San Diego: Singular.

Carr, P. (1999). *English phonetics and phonology.* Malden, Massachusetts: Blackwell Publishing.

Celce-Murcia, M., Brinton, D. & Goodwin, J. M. (1996). *Teaching pronunciation.* New York: Cambridge University Press.

Cristófaro Silva, T. (2002). *Fonética e fonologia do português: Roteiro de estudos e guia de exercicios*. São Paulo: Contexto.

Cruttenden, A. (1979). *Language in infancy and childhood*. Manchester: Manchester University Press.

Cruttenden, A., & Gimson, A. C. (2001). *Gimson's pronunciation of English.* London: Arnold.

Crystal, D. (1997). *The cambridge encyclopedia of language, second edition*. Cambridge: Cambridge University Press.Z

Ellis, R. (1994). *The study of second language acquisition.* Oxford: Oxford University Press.

Essen, O. von. (1964). An acoustic explanation of the sound shift [l] > [u] and [l] > [i]. In D. Abercrombie, D. B. Fry, P. A. D. MacCarthy, N. C. Scott & J. L. M. Trim (Eds.), *In honour of Daniel Jones* (p. 52-58). London: Longmans.

Fails, W. C. and Clegg, J. H. (1992) A spectrographic analysis of portuguese stressed and unstressed vowels. In D. A. Koike & D. P. Macedo (Eds.), *Romance linguistics: the Portuguese context.* Westport, Conn: Bergin & Garvey.

Feldman, D. (1972). On utterance-final [l] and [u] in Portuguese. In A. Valdman (Ed.), *Papers in linguistics and phonetics to the memory of P. Delattre* (pp.129-141). The Hague: Mouton.

Ferguson, C. A., Menn, L. & Stoel-Gammon, C. (1992) *Phonological Development: Models, Research, Implications* (pp. 75-76). Timonium, Maryland: York Press.

Ferreira, A. B. d. H., Anjos, M. d., Ferreira, M. B., & Ferreira, A. B. d. H. (1999). *Aurélio século XXI: o dicionário da língua portuguesa*. Rio de Janeiro: Editora Nova Fronteira.

Flege, J. E. (1995). Second language speech learning theory, findings and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 233-277). Timonium, MD: York Press.

Flege, J. E. (ms). Assessing non-natives' perception of English vowels: a categorical discrimination test. Unpublished manuscript.

Flege, J. E., Bohn, O. & Jang, S. (1997). Effects of experience on non-native speakers' production and perception of English vowels. *Journal of Phonetics*, *25*(4), 437-470.

Flege, J. E., Munro, M. J., & Fox, R. A. (1994). Auditory and categorical effects on crosslanguage vowel perception. *Journal of the Acoustical Society of America*, *95*(6), 3623-3641.

Foulkes, P. (1999). *Urban voices: Accent studies in the british isles.* London: Arnold Publishers.

Fujimura, O. & Erickson, D. (1997) Acoustic phonetics. In W. J. Hardcastle & J. Laver (Eds.), The *handbook of phonetic sciences* (pp. 64-115). Oxford: Blackwell

Garson, G. D. "Data Imputation from Missing Values", from *Statnotes: Topics in Multivariate Analysis*. Retrieved 20 October 2007 from North Carolina State University http://www2.chass.ncsu.edu/garson/pa765/missing.htm.

Gesuato, Sara. (1996) Perception of alveolar and velar allophones of English /l/ in word-initial and word-final positions. In J. Johnson, M. L. Juge, & J. L. Moxley, (eds.), *Proceedings of the 22nd annual meeting of the Berkeley Linguistics Society,* (p. 116-131)

Giegerich, H. J. (1992). *English phonology: An introduction.* Cambridge: Cambridge University Press.

Grammont, M. (1971). *Traité de phonétique,* 9th edition. Paris: Delagrave, quoted in Recasens, below.

Hardcastle, W. & Barry, W. (1989). Articulatory and perceptual factors in /l/ vocalizations in English. *Journal of the International Phonetic Association 15*, 3-17.

Horvath, B. M. & Horvath, R. J. (2002). The geolinguistics of /l/ vocalization in Australia and New Zealand. *Journal of Sociolinguistics*, *6*(3), 319.

Johnson, W. & Britain, D. (2003). L Vocalisation as a Natural Phenomenon. Retrieved 5 May 2005 from Essex University, Essex Research Reports in Linguistics web site: http://www.essex.ac.uk/linguistics/wkpaps/

Jones, D. (1958). *The pronunciation of English. (4th ed., rev. and enl.; reprinted with minor corr.).* Cambridge: University Press.

Jones, M. J. (2005). *Historical linguistics: sound change and reconstruction.* Retrieved 9 August 2005 from University of Cambridge, Phonetics Laboratory web site: http://kiri.ling.cam.ac.uk/mark/2005SOE3.pdf

Katamba, F. (1989). *An introduction to phonology.* London/New York: Longman.

Kluge, D.C. (2004). *The perception and production of English syllable-final nasals by Brazilians learners*. Unpublished master's thesis. Florianópolis, Brazil: Universidade Federal de Santa Catarina.

Koerich, R. D. (2002). *Perception and production of word-final vowel epenthesis by Brazilian EFL students.* Unpublished doctoral dissertation. Florianópolis, Brazil: Universidade Federal de Santa Catarina.

Krapp, G. P. (1919). *The pronunciation of standard English in America.* New York: Oxford University Press, American Branch.

Kuhl, P. K. (1993). Early linguistic experience and phonetic perception: implications for theories of developmental speech perception. *Journal of Phonetics, 21*, 125-139.

Ladefoged, P. (1982). *A course in phonetics* (2nd ed.). San Diego: Harcourt Brace Jovanovich.

Ladefoged, P. (2001). *A course in phonetics* (4th ed.). Fort Worth: Harcourt College Publishers.

Ladefoged, P., & Maddieson, I. (1986). Some of the sounds of the world's languages. *UCLA working papers in phonetics, v. 64.* Los Angeles: Phonetics Laboratory, Dept. of Linguistics, UCLA.

Ladefoged, P. and Maddieson, I. (1996). *The sounds of the world's languages*. Oxford: Blackwell Publishers.

Landau, S. I. (2001). *Cambridge dictionary of American English.* Cambridge: Cambridge University Press.

Leather J. & James, A. (1996) Second language speech. In W. C. Ritchie & T. K. Bhatia (Eds.), *Handbook of second language acquisition* (pp. 269-316). San Diego: Singular.

Lehiste, I. (1964). *Acoustic characteristics of selected english consonants*. Bloomington: Indiana University Research Center in Anthropology, Folklore and Linguistics, quoted in Recasens, below.

Mateus, M. H. & d'Andrade, E. (2000). *The phonology of Portuguese,* Oxford: Oxford University Press.

Merriam-Webster, Inc. (2002). *Merriam-Webster's collegiate dictionary*. Springfield, Mass: Merriam-Webster.

Merriam-Webster Online Dictionary. (2005-2007). http://www.merriam-webster.com.

Michaelis, H. (2001). *Michaelis: dicionário escolar inglês. Inglês - Português, Português - Inglês.* São Paulo: Melhoramentos.

Moore, D. H. (2005). The Perception of English word-final /l/ by Brazilian learners of English. Unpublished manuscript. Florianópolis, Brazil: UFSC.

Moore, D. H. (2006). An investigation of English word-final /l/ and Portuguese word-final /w/ as spoken by a single native speaker of both languages. Unpublished manuscript. Florianópolis, Brazil: UFSC.

Oxford University Press. (1995). *The Oxford English dictionary on compact disc*. Oxford: Oxford University Press.

Recasens, D. (1996). An Articulatory-Perceptual Account of Vocalization and Elision of Dark /l/ in the Romance Languages. *Language and Speech 39*(1) pp. 63-89.

Reis, M. S. (2006). *The Perception of English Interdental Fricatives by Brazilian EFL Learners.* Unpublished master's thesis. Florianópolis, Brazil: UFSC.

Rochet, B. L. (1995). Perception and production of second-language speech sounds by adults. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 379-411). Timonium, MD: York Press.

Rumsey, D. (2007). *Intermediate Statistics For Dummies.* Indianapolis: John Wiley & Sons.

Sander, E. K. (1972). When are speech sounds learned? *Journal of Speech and Hearing Disorders*, *37*, 62.

Spiegel, M. R., & Stephens, L. J. (1999). *Schaum's outline of theory and problems of statistics.* New York: McGraw-Hill.

Sproat, R. & Fujimura, O. (1993). Allophonic variation in English /l/ and its implications for phonetic implementation. *Journal of Phonetics 21,* 291-311.

Wells, J. C. (1982). *Accents of English,* (3 Vols.). Cambridge: Cambridge University Press.

Wells, J.C., (1994). Transcribing Estuary English: a discussion document. *Speech Hearing & Language 8*, 261-267.

Wiese, H. (2003). *Numbers, language, and the human mind.* Cambridge: Cambridge University Press.

Wright, J. (1905). *English dialect grammar.* Oxford: Oxford University Press.

Yallop, C. (1995). *An Introduction to Phonetics and Phonology*. Malden, MA: Blackwell Publishing.

Appendix 1: Questionnaire

The questionnaire as presented here contains all original questions, but in a different format from the original. Plenty of space was allowed for participants to write their responses.

Nome _____ Idade _____
Turma _____

1. De onde você é? Caso tenha morado em vários lugares durante a infância, quanto tempo passou em cada um?

2. Qual é seu sotaque? (catarinense, rio grandense, paranaense, paulista, carioca, etc.)

3. Qual é o sotaque que você ouviu mais durante a infância (o dos seus pais, seus avos, sua babá, por exemplo "meus pais – Mãe é de uma pequena aldeia de Santa Catarina, Pai é de uma cidadezinha de São Paulo" ou "meus avós – ambos do interior de São Paulo")?

4. Já esteve num país onde se fala inglês? Por favor, descreva detalhadamente. Onde foi? Quando? Quanto tempo tinha estudado inglês quando foi?

5. Já esteve em qualquer outro país estrangeiro? Por favor, descreva detalhadamente. Qual país? Quando? Quanto tempo estudou inglês antes de ir?

6. Como você aprendeu inglês? Estudou no segundo grau? Em escola de idiomas? Estudo casual? Aulas particulares? Você aprendeu "naturalmente", apenas por estar em um lugar onde todos falavam inglês? Por favor descreve a maneira em que você aprendeu. (i.e. Duas aulas de uma hora e meia cada semana por dois anos na Cultura Inglesa, que é uma escola particular, etc.)

7. Com que freqüência em outras aulas de inglês você escutou gravações de falantes nativos de inglês?

8. Você fala outros idiomas além de português e inglês? Como você os aprendeu? (X anos de estudo no colégio, aulas particulares, contato, etc.)

9. Já foi aluno de um falante nativo? Se sim, por quanto tempo? Quando? De onde era o professor?

10. Já estudou outras línguas com falante nativo? Se sim, por quanto tempo? Quando? De onde era o professor e qual foi a língua?

11. Já teve muito contato com português de Portugal? Se sim, por favor, descreva em detalhes.

12. Já teve muito contato com pessoas com 60 anos ou mais do Rio Grande do Sul? Se sim, por favor descreva em detalhes.

13. Já teve contato com falantes nativos de outras línguas? Se sim, por favor descreva em detalhes.

14. Qual é o seu nível de contato com falantes nativos de inglês? Por favor, descreve em detalhes – por quanto tempo, com que freqüência, etc. Com que freqüência falou com eles em inglês?

15. Você diria que teve muito ou pouco treinamento na pronúncia do inglês? Por favor descreva o treinamento (como foi ensinado a pronunciá-lo, ou como o "L" foi descrito).

16. Qual é seu teor de contato com inglês fora da sala de aula?

Tipo de conteudo	*Frequência: Todo dia? Muitas vezes por semana? Semanalmente? Algumas vezes por mês?*
filme	_____
TV	_____
música	_____
livros/histórias	_____
revistas	_____
jornais	_____
email	_____
messenger	_____
internet	_____
outro _____	_____

_____

17. Por favor, escreva aqui qualquer outra coisa sobre seu contato com inglês que achar interessante.

Appendix 2: Instructions

The sheet handed to Brazilian participants contained instructions in both English and Portuguese for clarity.

First of all, thank you very much for participating!

This activity is a test of perception of words that end with the English "L" sound compared with words that don't end in this sound. Sometimes the other words will be in English, sometimes in Portuguese.

There are 7 parts to the test:

First is a very brief training exercise for parts one and two.

Parts 1 & 2. Pick the item that is different.
You will hear 3 words. Choose the word that is different from the others.
If all words are the same, choose "same."

Parts 3 & 4. Determine if the words are the same or different.

Part 5. Do you hear English or Portuguese?

Part 6. Does the word end in English "L" or not?

Thanks again!

Primeiramente, muito obrigado pela sua participação!

Esta atividade é um teste de percepção de palavras que terminam no "L" inglês em comparação a palavras que não terminam neste som. Às vezes, as outras palavras serão em inglês, às vezes em português.

Tem 7 partes no teste:

Primeiro é um treinamento curto para partes 1 e 2.

Parte 1 & 2. Escolha o item que é diferente.
Você vai ouvir 3 palavras. Escolha a palavra que é diferente das outras.
Se todas as palavras são iguais, escolha "same."

Partes 3 & 4. Determine se as palavras são iguais ou não.

Parte 5. Você ouve inglês ou português?

Parte 6. A palavra termina em "L" inglês ou não?

Obrigado de novo!

Appendix 3: Response sheets

Examples

	1	2	3	Same
1				
2				
3				
4				

Name: _____

Age: _____

Part 1 – Port./English: select the odd word. If all words are the same, select "same."

	1	2	3	Same
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				

	1	2	3	Same
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				

Second response sheet:

Part 2 - English only: select the odd word. If all words are the same, select "same."

	1	2	3	Same
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

	1	2	3	Same
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				

Part 3 – Same or Different?

	Different	Same
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

	Different	Same
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		

Part 4 – Same or Different?

	Different	Same
1		
2		
3		
4		
5		
6		
7		
8		

	Different	Same
9		
10		
11		
12		
13		
14		
15		
16		

Third response sheet:

Part 5 – English/Portuguese: What language do you hear?

	English	Portuguese
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

	English	Portuguese
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Part 6 – English Only: Identify the final sound

	"L" as in "tool"	Not "L"
1		
2		
3		
4		
5		
6		
7		
8		

	"L" as in "tool"	Not "L"
9		
10		
11		
12		
13		
14		
15		
16		

Appendix 4: Possibility Exhauster

This appendix shows words considered when designing the tests. At this stage, all possibilities–from rough matches to idiosyncratic or dialectal pronunciations–were reviewed. Phonemic judgements were loose, so some words appear in multiple places. English words ending in /l/ and /ʊ/ for each vowel are in the first two columns; Portuguese words are in the third.

/aɪl/	/aɪʊ/	Portuguese	/ɛl/	/ɛʊ/	Portuguese
aisle		aio	bell		bel
bile	bayou	baio	kell		
kyle		caio	dell		déu
dial			fell		fel
file			Gell		
guile			hell		
heil	ohio	raio	jell		
kyle			quell		
lyle					Leo
mile		maio	mel		mel
nile			nell		neo
pile		paio	pell		
rile			quell		
sigh'll		saio	sell		céu
shy'll			shell		
tile			tell		téu
vile	vaio		well		
while			yell		

/ol/	/oʊ/	Portuguese	/il/	/iʊ/	Portuguese
bowl	bow	acabou	beal		
coal	Coe	secou	deal		dio
dole	dough	dou	eel		io
foal	foe	safou	feel		fio
goal	go	gol/cegou	heel/heal		rio
hole	hoe				io
	joe		congeal		dio
	low	falou	keel		
mole	mow	amou			lio
	know		meal		mio/mil
pole	Poe	empou	neal		
role	row		peel		pio
sole/soul	sew	sou	real		
shoal	show	show	seal		cio
stole		stou	she'll		chio
toll	tow	estou/catou	teal		tio/til
vole		vou/vôo	veal		vil
	whoa		wheel		
	yo		zeal		

/ul/	/u/	Portuguese
	boo	
cool	coo	facul
	chew	
dool	do	
fool	foo	ful
ghoul	goo	
who'll	hoo	
joule	Jew	
kool	Kew	
	Lou	
mule	mew	
	new	
pool	poo	pul
	queue	
rule		
sue'll	sue	sul
shoe'll	shoe	chuchu
tool	too	
	oo	
	woo	
yule	you	
	zoo	

/eɪl/	/eɪʊ/	Portuguese
bail		
kale		
dale		
fail		feio
gail		
hail		reio
jail		
kale		
mail		meio
nail		
pail		
quail		
rail		
sail		seio
shale		cheio
tail		
vail/veil		veio
whale		
yale		
ail		

/ɔl/	/ɔʊ/	Portuguese
awl		
bawl		futebol
cawl		skol
doll		
gaul		
haul		rol
		skol
knoll		nó
maul		mol
paul		pó
saul		sol
shawl		

/æl/	/aʊ/	Portuguese
al	ow	al
	bow	BAL
cal	cow	cal
	dow	dal
fal		
gal/gall		gal
hal	how	
mal		mal
nal	now	nau
pal		pau/PAL
sal	sow	sal
		tal
val		val

/aʊl/	/aʊ/	Portuguese
owl	ow	al
	bow	bal
cowl	cow	cal
	chow	tchau
dowel	dow	dal
foul		
	gal	gal
howl	how	
jowl		
	Mao	mal
	now	

/aʊl/	/aʊ/	Portuguese
pow(e)ll	pow	pau
		qual
	row	
	sow	sal
shall		
tow(e)l		tal
vowel	vow	val
	wow	
yowl		

Appendix 5: Reanalysis without participant IK

A5.1 Considering IK's responses

One participant in the Intermediate group, who shall be identified as IK, stood out from the rest for his unusual results. IK's error rate on Test 1, the first CDT, was much higher than his error rate on any of the other tests at 56.36% with only one non-response. This extreme error rate was identified as an outlier on a boxplot of Test 1 error rates in the software Minitab and by Grubb's test. Several possibilities could explain this anomaly - an error in his responses, confusion surrounding the test, or genuine poor performance.

Misrecording responses, the simplest error to discover, was tested for by taking responses after the non-response and shifting them one cell in either direction to see whether the pattern of errors changed dramatically. It barely changed at all. Since all responses were checked twice when entered into the computer, recording error on the part of the researcher was ruled out as well.

Could the results have been due to confusion? His error rate on Test 1 was 56.36%, while the rest of his error rates were 25.00%, 21.43%, 0.00%, 15.79% and 31.25% on Tests 2 through 6, respectively. There were only two non-responses, on Tests 1 and 5. The second-highest error rate on Test 1, from an Advanced student whose error rates were generally high, AN, was 33.93%, more than 22 percentage points lower. IK's high error rate on Test 1 compared to the other tests would seem to suggest that it confused him. Further suggesting that confusion was at the root of his poor performance, he made no errors on the /aɪ/, /ɛ/, and /eɪ/ vowel contexts anywhere but in the first test.

However, a close examination of his results found that IK performed very well in both Test 1 (25%) and overall (16.67%) in the /u/ context, despite his high *total* number of errors in Test 1. Too, the vowel contexts with his worst error rates on Test 1

remained the two contexts with the worst performance on the other English/Portuguese tests when Test 1 was removed. Most confounding to the notion of confusion as the fault forming factor is that Test 2, on which his error rate was only 25%, was also a CDT, and neither new directions nor review were provided between the tests. Confusion alone seems unlikely as the source of error.

Table A5.1: IK's error numbers

Vowel	Error % Test 1 Only	Overall Error% Test 1 included	Overall Error % Test 1 removed
/ɛ/	62.5%	31.3%	0.0%
/ɔ/	87.5%	64.3%	33.3%
/i/	75.0%	62.5%	50.0%
/o/	62.5%	35.5%	26.1%
/u/	25.0%	16.7%	13.6%
/aɪ/	25.0%	6.7%	0.0%
/aʊ/		43.8%	43.8%
/eɪ/	57.1%	30.8%	0.0%

As you will recall, tests with high non-response rates were considered a mark of confusion for these analyses, and were entirely removed from consideration in the initial analysis on a test-wise basis. But because IK's high error rate could not be attributed conclusively and solely to confusion, his Test 1 could not be considered in the same class as test responses with greater than 20% error rates.

To address IK's odd response here, the Total Error Rate analysis, all vowel context analyses, and the analysis of Test 1 were performed twice – once including his responses in Test 1 and once without them. The Total Error Rate analysis and each vowel context analysis would be affected by the removal of an entire test from evaluation, so each was analyzed again. But for analysis of the total error rates by test, only Test 1 would need a second analysis.

A5.2 Total Error Rate analysis

Error rates per group were rechecked for normality, and all three were found to be normal. Results were very similar numerically and supported the same statistical conclusions with a high degree of statistical certainty (see chart below).

A5.3 Vowel Context analyses

First, all error rates per group were rechecked for normality, and all vowel contexts were found to follow the pattern established by the full responses, so the same type of analysis, one-way ANOVA or Kruskal-Wallis, could be used. Most results featured very similar *p* values to the principal analysis, and all supported the same conclusions as the original tests (see table below).

Table A5.3: Total Error Rate and Vowel analysis with and without IK

Test	With IK	No IK	Conclusion
One-way ANOVA: TE vs. class	$p = 0.001$	$p = 0.001$ $F = 8.71$	at least two groups different Int and Adv not significantly different, NS < Int and Adv
One-way ANOVA: /ɛ/ vs. class	$p = 0.158$	$p = 0.093$ $F = 2.51$	all groups similar
One-way ANOVA: /ɔ/ vs. class	$p = 0.000$	$p = 0.000$ $F = 11.44$	at least two groups different Int and Adv not significantly different, NS < Int and Adv
Kruskal-Wallis: /i/ vs. class	$p = 0.151$	$p = 0.150$	all groups similar
One-way ANOVA: /o/ vs. class	$p = 0.005$	$p = 0.005$ $F = 5.96$	at least two groups different Int and Adv not significantly different, NS < Int and Adv
One-way ANOVA: /u/ vs. class	$p = 0.033$	$p = 0.034$ $F = 3.65$	at least two groups different Int and Adv not significantly different, NS < Int and Adv
One-way ANOVA: /aɪ/ vs. class	$p = 0.129$	$p = 0.093$ $F = 2.50$	all groups similar
One-way ANOVA: /aʊ/ vs. class	$p = 0.049$	$p = 0.049$	at least two groups different no groups significantly different
Kruskal-Wallis: /eɪ/ vs. class	$p = 0.815$	$p = 0.915$ $F = 0.09$	all groups similar

A5.4 Test 1 analysis

Table A5.4: Test 1 analysis with and without IK

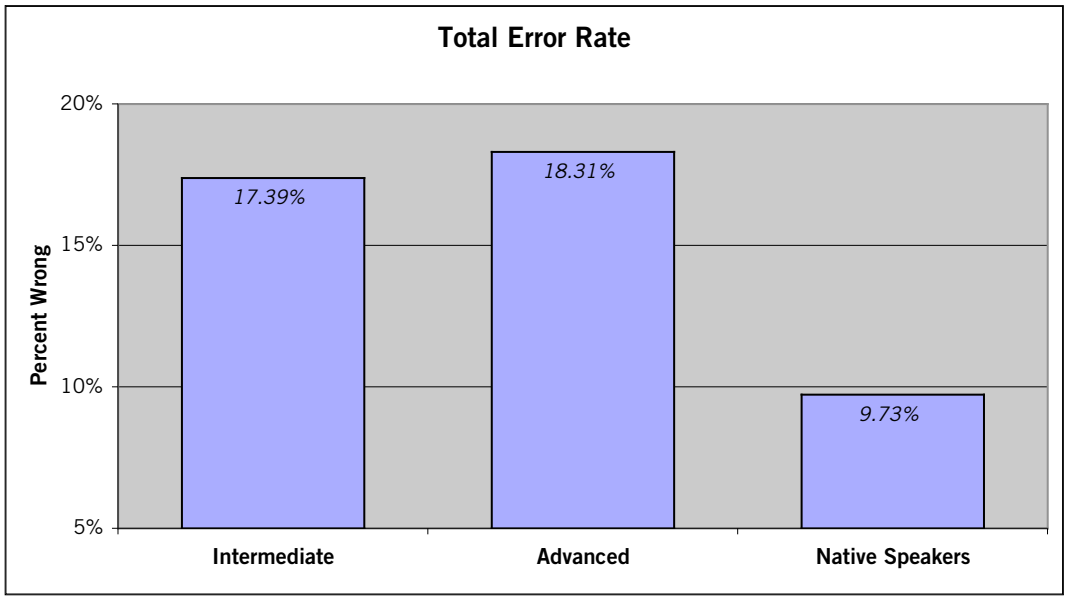
Means	With IK	No IK
Intermediate	14.20%	11.72%
Advanced	15.61%	15.61%
Native Speakers	7.74%	7.74%
Analyses		
With IK		
Kruskal-Wallis:	$p = 0.128$ adjusted for ties, no significant differences	
No IK		
Kruskal-Wallis:	$p = 0.150$ adjusted for ties, first finding supported	

In the case of Test 1 compared by group, IK's inclusion makes no difference. Without IK, Kruskal-Wallis finds that there is no difference ($p = 0.150$) among the groups, confirming the original findings.

Appendix 6: Reanalysis of Brazilians Ages 18-30 Only

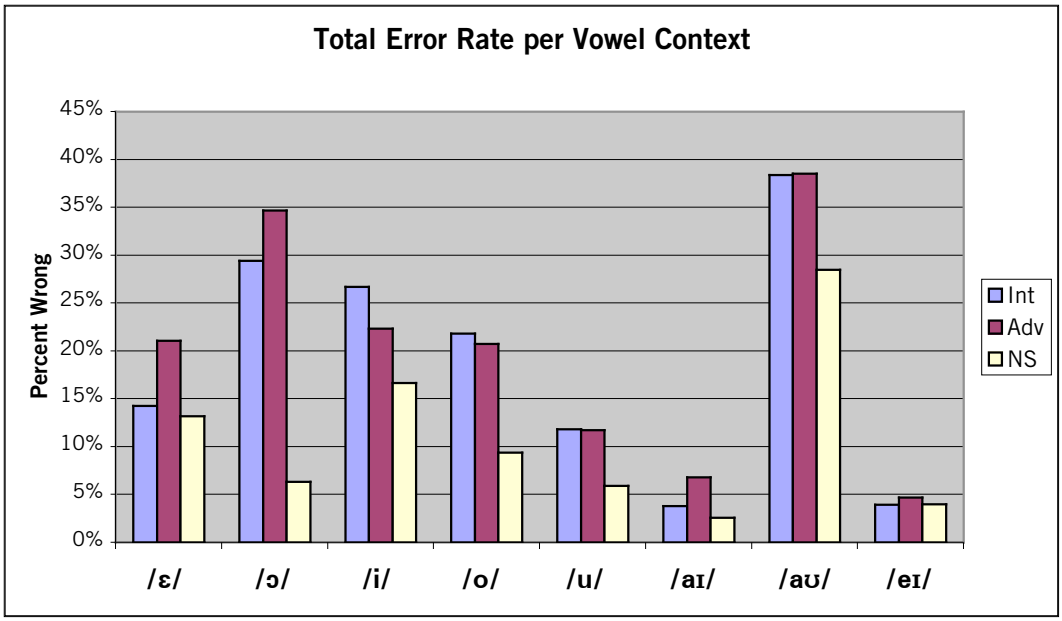
In this appendix, three graphs summarize the results of statistical tests performed using only data from participants between the ages of 18 and 30. Minitab's raw output follows the graphs.

Graph A6.1: Total Error Rates Compared (Ages 18-30)



Test	Conclusion
TE vs. class: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv

Graph A6.2: Error Rates per Vowel Context (Ages 18-30)

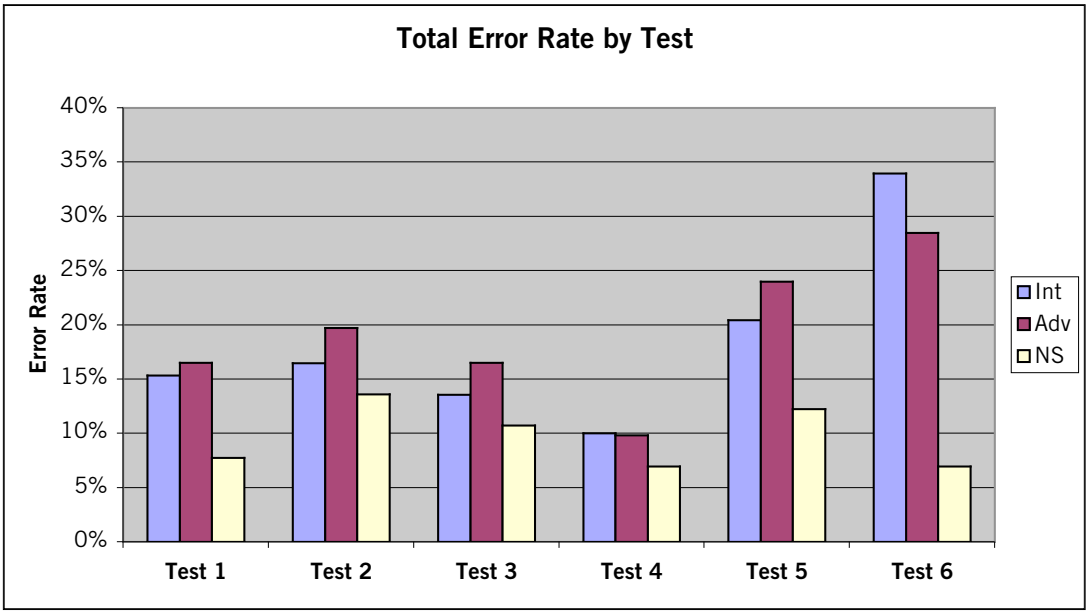


	/ɛ/	/ɔ/	/i/	/o/	/u/	/aɪ/	/aʊ/	/eɪ/
Intermediate	14.25%	29.44 %	26.72%	21.81%	11.84%	3.80%	38.39%	3.96%
Advanced	21.07%	34.67%	22.32%	20.74%	11.72%	6.81%	38.54%	4.68%
Native Speakers	13.19%	**6.35%***	16.67%	**9.39%***	**5.93%***	2.59%	28.47%	3.97%

Test	**Conclusion**
1-way ANOVA: /ɛ/ vs. class	no significant differences
1-way ANOVA: /ɔ/ vs. class	Int and Adv not significantly different, NS < Int and Adv
Kruskal-Wallis: /i/ vs. class	no significant differences
1-way ANOVA: /o/ vs. class	Int and Adv not significantly different, NS < Int and Adv
One-way ANOVA: /u/ vs. class	Int and Adv not significantly different, NS < Int and Adv
1-way ANOVA: /aɪ/ vs. class	no significant differences
1-way ANOVA: /aʊ/ vs. class	no significant differences
Kruskal-Wallis: /eɪ/ vs. class	no significant differences

* Significantly lower than Intermediate and Advanced.

Graph A6.3: Total Error Rates by Test (Ages 18-30)



	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
Intermediate	15.34%	16.47%	13.57%	10.00%	20.44%	33.94%
Advanced	16.49%	19.71%	16.52%	9.82%	23.99%	28.48%
Native Speakers	7.74%	13.58%	10.71%	6.94%	**12.22%****	**6.94%***

Test 1: Kruskal-Wallis	no significant differences
Test 2: 1-way ANOVA	no significant differences
Test 3: Kruskal-Wallis	no significant differences
Test 4: 1-way ANOVA	no significant differences
Test 5: 1-way ANOVA	Int and Adv not significantly different, NS < Adv
Test 6: 1-way ANOVA	Int and Adv not significantly different, NS < Int and Adv

* Significantly lower than Intermediate and Advanced. ** Significantly lower than Advanced

Minitab 15.1.1.0 Output for Ages 18-30

Results for: first analysis - outliers included

One-way ANOVA: TE% versus class

```
Source  DF       SS       MS     F      P
class    2  0.04577  0.02288  6.00  0.006
Error   35  0.13354  0.00382
Total   37  0.17931

S = 0.06177   R-Sq = 25.53%   R-Sq(adj) = 21.27%


                            Individual 95% CIs For Mean Based on Pooled StDev
Level   N     Mean    StDev  ---------+---------+---------+---------+
1      15  0.17392  0.06517                  (------*-----)
2      14  0.18310  0.07057                    (------*-----)
3       9  0.09727  0.03417  (-------*--------)
                            ---------+---------+---------+---------+
                                   0.100     0.150     0.200     0.250

Pooled StDev = 0.06177


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.04%


    class = 1 subtracted from:

    class     Lower    Center     Upper  ---------+---------+---------+---------+
    2      -0.04698   0.00918   0.06534              (------*------)
    3      -0.14037  -0.07665  -0.01293   (-------*-------)
                                        ---------+---------+---------+---------+
                                              -0.080     0.000     0.080     0.160


    class = 2 subtracted from:

    class     Lower    Center     Upper  ---------+---------+---------+---------+
    3      -0.15040  -0.08583  -0.02127  (-------*-------)
                                        ---------+---------+---------+---------+
                                              -0.080     0.000     0.080     0.160


**One-way ANOVA: εTE% versus class**

Source  DF      SS      MS     F      P
class    2  0.0467  0.0233  1.40  0.260
Error   35  0.5831  0.0167
Total   37  0.6297

S = 0.1291   R-Sq = 7.41%   R-Sq(adj) = 2.12%


                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean   StDev  ---+---------+---------+---------+------
1      15  0.1425  0.1020      (-----------*----------)
2      14  0.2107  0.1655                (-----------*-----------)
3       9  0.1319  0.1010  (--------------*--------------)
                          ---+---------+---------+---------+------
                           0.060     0.120     0.180     0.240

Pooled StDev = 0.1291
```

One-way ANOVA: ɔTE% versus class

```
Source  DF      SS      MS     F      P
class    2  0.4703  0.2352  8.90  0.001
Error   35  0.9253  0.0264
Total   37  1.3956

S = 0.1626   R-Sq = 33.70%   R-Sq(adj) = 29.91%


                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean   StDev  ---+---------+---------+---------+------
1      15  0.2944  0.1582                  (-----*----)
2      14  0.3467  0.2019                     (-----*-----)
3       9  0.0635  0.0753  (------*-------)
                          ---+---------+---------+---------+------
                           0.00      0.15      0.30      0.45

Pooled StDev = 0.1626


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.04%


    class = 1 subtracted from:

    class    Lower   Center    Upper  --------+---------+---------+---------+-
    2      -0.0955   0.0523   0.2001               (-----*-----)
    3      -0.3986  -0.2309  -0.0631    (------*-----)
                                       --------+---------+---------+---------+-
                                            -0.25      0.00      0.25      0.50


    class = 2 subtracted from:

    class    Lower   Center    Upper  --------+---------+---------+---------+-
    3      -0.4531  -0.2832  -0.1132  (------*-----)
                                       --------+---------+---------+---------+-
                                            -0.25      0.00      0.25      0.50
```

Kruskal-Wallis Test: iTE% versus class

```
class     N  Median  Ave Rank      Z
1        15  0.1875      21.1   0.72
2        14  0.1875      21.3   0.76
3         9  0.1875      14.1  -1.68
Overall  38              19.5

H = 2.83  DF = 2  P = 0.243
H = 3.08  DF = 2  P = 0.214  (adjusted for ties)


Means and StDev
Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean   StDev  --------+---------+---------+---------+-
1      15  0.2672  0.1755                  (--------*--------)
2      14  0.2232  0.0839            (---------*--------)
3       9  0.1667  0.0442  (-----------*-----------)
                          --------+---------+---------+---------+-
                                0.140     0.210     0.280     0.350

Pooled StDev = 0.1240
```

One-way ANOVA: oTE% versus class

```
Source  DF      SS      MS     F      P
class    2  0.0982  0.0491  4.41  0.020
Error   35  0.3899  0.0111
```

```
Total   37  0.4881

S = 0.1056   R-Sq = 20.12%   R-Sq(adj) = 15.55%


                           Individual 95% CIs For Mean Based on
                           Pooled StDev
Level   N    Mean   StDev  -------+---------+---------+---------+--
1      15  0.2181  0.0948                     (-------*-------)
2      14  0.2074  0.1361                   (--------*-------)
3       9  0.0939  0.0540  (---------*----------)
                           -------+---------+---------+---------+--
                                0.070     0.140     0.210     0.280

Pooled StDev = 0.1056


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.04%


    class = 1 subtracted from:

    class    Lower   Center    Upper  ---------+---------+---------+---------+
    2      -0.1067  -0.0107   0.0853            (-------*-------)
    3      -0.2331  -0.1242  -0.0153  (--------*--------)
                                     ---------+---------+---------+---------+
                                           -0.12      0.00      0.12      0.24


    class = 2 subtracted from:

    class    Lower   Center    Upper  ---------+---------+---------+---------+
    3      -0.2239  -0.1135  -0.0032  (---------*--------)
                                     ---------+---------+---------+---------+
                                           -0.12      0.00      0.12      0.24


One-way ANOVA: uTE% versus class

Source  DF       SS       MS     F      P
class    2  0.02354  0.01177  4.40  0.020
Error   35  0.09371  0.00268
Total   37  0.11725

S = 0.05174   R-Sq = 20.08%   R-Sq(adj) = 15.51%


                             Individual 95% CIs For Mean Based on
                             Pooled StDev
Level   N     Mean    StDev  ---+---------+---------+---------+------
1      15  0.11839  0.05638                    (-------*-------)
2      14  0.11717  0.05125                  (-------*-------)
3       9  0.05927  0.04339  (---------*---------)
                             ---+---------+---------+---------+------
                              0.035     0.070     0.105     0.140

Pooled StDev = 0.05174


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.04%


    class = 1 subtracted from:

    class     Lower    Center     Upper  ---------+---------+---------+---------+
    2      -0.04826  -0.00122   0.04583             (-------*-------)
    3      -0.11250  -0.05912  -0.00574  (--------*--------)
                                        ---------+---------+---------+---------+
                                              -0.060     0.000     0.060     0.120
```

```
    class = 2 subtracted from:

    class     Lower    Center     Upper  ---------+---------+---------+---------+
    3      -0.11199  -0.05790  -0.00382  (--------*--------)
                                         ---------+---------+---------+---------+
                                               -0.060     0.000     0.060     0.120
```

One-way ANOVA: aiTE% versus class

```
Source  DF       SS       MS     F      P
class    2  0.01144  0.00572  2.93  0.067
Error   35  0.06835  0.00195
Total   37  0.07979

S = 0.04419   R-Sq = 14.34%   R-Sq(adj) = 9.44%


                            Individual 95% CIs For Mean Based on
                            Pooled StDev
Level   N     Mean    StDev  --+---------+---------+---------+-------
1      15  0.03797  0.04256          (--------*--------)
2      14  0.06811  0.04636                    (--------*---------)
3       9  0.02591  0.04338  (-----------*-----------)
                            --+---------+---------+---------+-------
                            0.000     0.025     0.050     0.075

Pooled StDev = 0.04419
```

One-way ANOVA: auTE% versus class

```
Source  DF      SS      MS     F      P
class    2  0.0686  0.0343  1.81  0.178
Error   35  0.6624  0.0189
Total   37  0.7310

S = 0.1376   R-Sq = 9.38%   R-Sq(adj) = 4.21%


                           Individual 95% CIs For Mean Based on
                           Pooled StDev
Level   N    Mean   StDev  ---+---------+---------+---------+------
1      15  0.3839  0.1587                   (---------*---------)
2      14  0.3854  0.1263                  (----------*----------)
3       9  0.2847  0.1132  (-------------*------------)
                           ---+---------+---------+---------+------
                            0.210     0.280     0.350     0.420

Pooled StDev = 0.1376
```

Kruskal-Wallis Test: eiTE% versus class

```
class     N       Median  Ave Rank      Z
1        15  0.000000000      18.3  -0.54
2        14  0.000000000      19.8   0.14
3         9  0.000000000      21.0   0.46
Overall  38                   19.5

H = 0.35  DF = 2  P = 0.839
H = 0.50  DF = 2  P = 0.780  (adjusted for ties)

Means and StDev
Individual 95% CIs For Mean Based on
                            Pooled StDev
Level   N     Mean    StDev  ------+---------+---------+---------+---
1      15  0.03956  0.08528       (-------------*-------------)
2      14  0.04676  0.09573         (--------------*--------------)
3       9  0.03968  0.05190  (------------------*------------------)
                            ------+---------+---------+---------+---
                                0.000     0.030     0.060     0.090
```

```
Pooled StDev = 0.08324
```

Kruskal-Wallis Test: TE1% versus class

```
35 cases were used
3 cases contained missing values

class     N   Median  Ave Rank      Z
1        13  0.10710      20.3   1.01
2        13  0.17860      19.3   0.58
3         9  0.07140      12.8  -1.76
Overall  35               18.0

H = 3.14  DF = 2  P = 0.208
H = 3.17  DF = 2  P = 0.205  (adjusted for ties)

Means and StDev
Individual 95% CIs For Mean Based on Pooled StDev
Level   N    Mean   StDev    +---------+---------+---------+---------
1      13  0.1534  0.1342                  (----------*---------)
2      13  0.1649  0.1202                    (---------*----------)
3       9  0.0774  0.0346    (------------*------------)
                             +---------+---------+---------+---------
                           0.000     0.060     0.120     0.180

Pooled StDev = 0.1116
```

One-way ANOVA: TE2% versus class

```
Source  DF       SS       MS     F      P
class    2  0.02049  0.01025  1.22  0.306
Error   34  0.28436  0.00836
Total   36  0.30485

S = 0.09145   R-Sq = 6.72%   R-Sq(adj) = 1.23%


                             Individual 95% CIs For Mean Based on
                             Pooled StDev
Level   N     Mean    StDev  -----+---------+---------+---------+----
1      15  0.16467  0.09473         (---------*---------)
2      13  0.19712  0.10395               (---------*----------)
3       9  0.13579  0.06027  (-----------*------------)
                             -----+---------+---------+---------+----
                                0.100     0.150     0.200     0.250

Pooled StDev = 0.09145
```

Kruskal-Wallis Test: TE3% versus class

```
class     N  Median  Ave Rank      Z
1        15  0.1071      19.6   0.04
2        14  0.1429      23.0   1.50
3         9  0.1071      13.8  -1.75
Overall  38              19.5

H = 3.76  DF = 2  P = 0.153
H = 4.06  DF = 2  P = 0.131  (adjusted for ties)

Means and StDev
Individual 95% CIs For Mean Based on
                             Pooled StDev
Level   N     Mean    StDev  --+---------+---------+---------+-------
1      15  0.13571  0.05265             (---------*--------)
2      14  0.16521  0.08308                      (---------*---------)
3       9  0.10712  0.03574  (------------*-----------)
                             --+---------+---------+---------+-------
                             0.070     0.105     0.140     0.175

Pooled StDev = 0.06297
```

One-way ANOVA: TE4% versus class

```
Source  DF       SS       MS     F      P
class    2  0.00608  0.00304  0.47  0.629
Error   35  0.22624  0.00646
Total   37  0.23232

S = 0.08040   R-Sq = 2.62%   R-Sq(adj) = 0.00%


                            Individual 95% CIs For Mean Based on
                            Pooled StDev
Level   N     Mean    StDev  ------+---------+---------+---------+---
1      15  0.10000  0.07008              (-----------*-----------)
2      14  0.09821  0.10318             (-----------*------------)
3       9  0.06944  0.04886  (---------------*--------------)
                            ------+---------+---------+---------+---
                                0.035     0.070     0.105     0.140

Pooled StDev = 0.08040
```

One-way ANOVA: TE5% versus class

```
Source  DF      SS      MS     F      P
class    2  0.0750  0.0375  3.36  0.047
Error   34  0.3800  0.0112
Total   36  0.4551

S = 0.1057   R-Sq = 16.49%   R-Sq(adj) = 11.58%


                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean   StDev  ---+---------+---------+---------+------
1      15  0.2044  0.1055               (-------*-------)
2      13  0.2399  0.0973                    (-------*--------)
3       9  0.1222  0.1176  (---------*----------)
                          ---+---------+---------+---------+------
                           0.070     0.140     0.210     0.280

Pooled StDev = 0.1057


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.06%


    class = 1 subtracted from:

    class    Lower   Center   Upper  ---------+---------+---------+---------+
    2      -0.0628   0.0355  0.1338               (-------*-------)
    3      -0.1915  -0.0822  0.0272     (--------*--------)
                                     ---------+---------+---------+---------+
                                           -0.12      0.00      0.12      0.24


    class = 2 subtracted from:

    class    Lower   Center    Upper  ---------+---------+---------+---------+
    3      -0.2301  -0.1177  -0.0052  (--------*---------)
                                      ---------+---------+---------+---------+
                                            -0.12      0.00      0.12      0.24
```

One-way ANOVA: TE6% versus class

```
Source  DF      SS      MS      F      P
class    2  0.4293  0.2146  14.98  0.000
Error   35  0.5014  0.0143
Total   37  0.9307
```

```
S = 0.1197   R-Sq = 46.13%   R-Sq(adj) = 43.05%


                          Individual 95% CIs For Mean Based on
                          Pooled StDev
Level   N    Mean   StDev   -+---------+---------+---------+--------
1      15  0.3394  0.1430                          (----*-----)
2      14  0.2848  0.1126                     (-----*----)
3       9  0.0694  0.0793   (------*------)
                           -+---------+---------+---------+--------
                          0.00      0.12      0.24      0.36

Pooled StDev = 0.1197


    Tukey 95% Simultaneous Confidence Intervals
    All Pairwise Comparisons among Levels of class

    Individual confidence level = 98.04%


    class = 1 subtracted from:

    class    Lower   Center    Upper     +---------+---------+---------+---------
    2      -0.1634  -0.0546   0.0542                 (----*-----)
    3      -0.3935  -0.2700  -0.1465     (-----*------)
                                        +---------+---------+---------+---------
                                     -0.40     -0.20      0.00      0.20


    class = 2 subtracted from:

    class    Lower   Center    Upper     +---------+---------+---------+---------
    3      -0.3405  -0.2154  -0.0903        (-----*-----)
                                        +---------+---------+---------+---------
                                     -0.40     -0.20      0.00      0.20
```

Appendix 7: All Universal correlations

Exhaustive correlation analysis of sex and age was also performed using listwise deletion and with outliers removed. Outliers were removed on the same basis as they were removed from the Brazilian-only correlation tests. One item per group was shown to be a mild outlier on boxplots in Minitab, but this finding was not confirmed by Grubb's test. Again, analysis was performed out of curiosity. The results did not differ extremely from the original analysis with the exception of "Brazilians only, no outliers - Sex." Both outliers were male, and this obviously affected the outcome of the correlation equation for sex and Total Error Rate. Still, no findings were significant.

Chart A7.1: Universal Correlations – Exhaustive Analysis

Variable	Measurement	Test type	Result
All Groups - Sex	male/female	point-biserial	$r = -0.087$, $p = 0.533$
All Groups - Age	numerical age	Pearson's r	$r = -0.020$, $p = 0.891$
All Groups, no outliers - Sex	male/female	point-biserial	$r = -0.231$, $p = 0.118$
All Groups, no outliers - Age	numerical age	Pearson's r	$r = 0.009$, $p = 0.952$
Brazilians only - Sex	male/female	point-biserial	$r = -0.087$, $p = 0.595$
Brazilians only - Age	numerical age	Pearson's r	$r = 0.080$, $p = 0.625$
Brazilians only, no NR - Sex	male/female	point-biserial	$r = -0.165$, $p = 0.421$
Brazilians only, no NR - Age	numerical age	Pearson's r	$r = 0.110$, $p = 0.593$
Brazilians only, no outliers - Sex	male/female	point-biserial	$r = -0.281$, $p = 0.088$
Brazilians only, no outliers - Age	numerical age	Pearson's r	$r = 0.126$, $p = 0.450$

Appendix 8: All Intermediate and Advanced correlations for Brazilian students

Table A8.1a Correlations: primary analysis

Variable	Measurement	Test type	Result
Place of origin	region (S, SE, CW, NE)	ANOVA	$p = 0.831$
Accent heard when growing up	region (S, SE, other)	ANOVA	$p = 0.407$
Self-reported accent	region (S, SE, indeterminate)	ANOVA	$p = 0.705$
Teacher's evaluation of student	above avg, avg, below avg	Pearson's r	$r = 0.262$, $p = 0.102$
English-speaking country exp.	none, little, extensive	Pearson's r	$r = 0.218$, $p = 0.176$
Other foreign country experience	yes/no	point-biserial	$r = 0.125$, $p = 0.477$
Native speaker audio in class	none, little, much	Pearson's r	$r = -0.142$, $p = 0.396$
Speak other languages?	yes/no	point-biserial	$r = -0.101$, $p = 0.539$
Other native Eng-speaking teacher?	yes/no	point-biserial	◗ $r = 0.298$, $p = 0.066$
Contact w/ Continental Portuguese?	none, little, much	Pearson's r	$r = 0.009$, $p = 0.956$
Contact with older Riograndenses?	yes/no	point-biserial	◗ $r = -0.308$, $p = 0.056$
Contact with NS of English	little outside class, regular	point-biserial	$r = 0.084$, $p = 0.623$

Table A8.1b Correlations: no non-responders

Variable	Measurement	Test type	Result
Place of origin	region (S, SE, CW)	ANOVA	$p = 0.855$
Accent heard when growing up	region (S, SE, other)	ANOVA	$p = 0.965$
Self-reported accent	region (S, SE, indeterminate)	ANOVA	$p = 0.497$
Teacher's evaluation of student	above avg, avg, below avg	Pearson's r	$r = -0.202$, $p = 0.321$
English-speaking country exp.	none, little, extensive	Pearson's r	$r = 0.307$, $p = 0.128$
Other foreign country experience	yes/no	point-biserial	$r = -0.217$, $p = 0.286$
Native speaker audio in class	none, little, much	Pearson's r	$r = -0.206$, $p = 0.323$
Speak other languages?	yes/no	point-biserial	◗ $r = -0.372$, $p = 0.061$
Other native Eng-speaking teacher?	yes/no	point-biserial	$r = 0.308$, $p = 0.126$
Contact w/ Continental Portuguese?	none, little, much	Pearson's r	$r = -0.145$, $p = 0.479$
Contact with older Riograndenses?	yes/no	point-biserial	◗ $r = -0.377$, $p = 0.057$
Contact with NS of English	little outside class, regular	point-biserial	$r = 0.015$, $p = 0.944$

Table A8.1c Correlations: no outliers

Variable	Measurement	Test type	Result
Place of origin	region (S, SE, CW, NE)	ANOVA	$p = 0.814$
Accent heard when growing up	region (S, SE, other)	ANOVA	$p = 0.973$
Self-reported accent	region (S, SE, indeterminate)	ANOVA	$p = 0.596$
Teacher's evaluation of student	above avg, avg, below avg	Pearson's r	$r = -0.182$, $p = 0.275$
English-speaking country experience	none, little, extensive	Pearson's r	$r = 0.218$, $p = 0.188$
Other foreign country experience	yes/no	point-biserial	$r = -0.146$, $p = 0.390$
Native speaker audio in class	none, little, much	Pearson's r	$r = -0.135$, $p = 0.431$
Speak other languages?	yes/no	point-biserial	$r = -0.235$, $p = 0.162$
Other native Eng-speaking teacher?	yes/no	point-biserial	◗ $r = 0.342$, $p = 0.038$
Contact w/ Continental Portuguese?	none, little, much	Pearson's r	$r = -0.081$, $p = 0.633$
Contact with older Riograndenses?	yes/no	point-biserial	◗ $r = -0.416$, $p = 0.010$
Contact with NS of English	little outside class, regular	point-biserial	$r = 0.162$, $p = 0.354$

Appendix 9: Results summarized by vowel

Participants are listed by code, with the first letter indicating Intermediate, Advanced or Native Speaker. All numbers are percentages.

Code	/ɛ/	/ɔ/	/i/	/o/	/u/	/aɪ/	/eɪ/	/aʊ/	TE%
IA	0.00	42.86	12.50	21.88	13.33	0.00	0.00	43.75	15.48
IB	25.00	35.71	18.75	18.75	10.00	3.33	7.14	37.50	17.26
IC	0.00	33.33	50.00	16.67	18.18	9.09	0.00	37.50	19.64
ID	6.25	28.57	31.25	21.88	10.00	0.00	0.00	25.00	14.29
IE	12.50	28.57	18.75	6.25	3.33	0.00	0.00	25.00	9.52
IF	0.00	7.14	18.75	25.00	6.67	0.00	0.00	31.25	11.31
IG	12.50	28.57	18.75	25.00	3.33	3.33	0.00	50.00	16.07
IH	25.00	25.00	27.27	26.67	11.54	3.85	16.67	37.50	20.00
II	6.25	21.43	18.75	31.25	10.00	0.00	7.14	50.00	17.26
IJ	7.14	21.43	12.50	12.90	10.00	0.00	0.00	37.50	11.52
IK	31.25	64.29	62.50	35.48	16.67	6.67	30.77	43.75	31.93
IL	31.25	14.29	18.75	31.25	10.34	0.00	0.00	75.00	20.96
IM	18.75	21.43	12.50	15.63	6.67	0.00	0.00	43.75	13.10
IN	25.00	21.43	18.75	9.38	10.00	0.00	7.14	25.00	12.50
IO	25.00	0.00	62.50	25.00	22.73	4.55	0.00	43.75	23.21
IP	20.00	15.38	13.33	28.13	10.00	3.33	0.00	7.14	12.88
IQ	18.75	28.57	18.75	18.75	16.67	10.00	0.00	56.25	19.64
IR	6.25	46.15	12.50	34.38	6.67	0.00	0.00	56.25	18.56
IS	12.50	42.86	31.25	43.75	16.67	13.33	14.29	75.00	29.76
IT	6.25	42.86	12.50	15.63	13.33	3.33	0.00	31.25	14.29
AA	25.00	64.29	12.50	40.63	10.00	6.67	0.00	56.25	25.00
AB	6.25	8.33	18.75	6.25	10.00	6.67	7.14	33.33	10.91
AC	6.25	57.14	12.50	18.75	16.67	3.33	0.00	50.00	18.45
AD	6.25	14.29	18.75	12.50	6.67	10.00	0.00	18.75	10.71
AE	18.75	28.57	25.00	25.00	3.33	0.00	7.14	43.75	16.67
AF	50.00	57.14	18.75	50.00	13.33	3.33	0.00	50.00	28.57
AG	12.50	21.43	25.00	18.75	16.67	10.00	0.00	37.50	17.26
AH	20.00	21.43	12.50	32.26	13.33	0.00	7.14	43.75	18.07
AI	25.00	25.00	25.00	13.33	3.57	11.54	8.33	25.00	14.86
AJ	25.00	35.71	25.00	7.69	7.69	0.00	0.00	54.55	15.23
AK	12.50	14.29	25.00	3.13	10.00	6.67	0.00	25.00	10.71
AL	0.00	50.00	50.00	15.38	16.67	0.00	0.00	37.50	18.97
AM	43.75	57.14	37.50	18.75	13.33	10.00	7.14	25.00	23.21
AN	50.00	61.54	31.25	32.26	23.33	16.67	35.71	50.00	33.73
AO	12.50	35.71	12.50	31.25	6.67	0.00	14.29	43.75	17.86
AP	12.50	33.33	37.50	6.25	7.14	7.14	0.00	37.50	15.00
AQ	0.00	21.43	18.75	21.88	6.67	0.00	0.00	31.25	11.90
AR	56.25	38.46	31.25	25.00	24.14	13.33	0.00	60.00	28.83
AS	25.00	7.14	18.75	25.00	3.33	3.33	14.29	50.00	16.67
AT	25.00	28.57	18.75	15.63	13.33	3.33	0.00	56.25	17.96
NA	12.50	14.29	18.75	9.38	3.33	0.00	0.00	18.75	8.33
NB	0.00	0.00	12.50	6.25	0.00	3.33	0.00	18.75	4.76
NC	31.25	14.29	25.00	12.50	13.33	0.00	0.00	25.00	13.69
ND	18.75	14.29	18.75	15.63	6.67	0.00	0.00	50.00	13.69
NE	6.25	0.00	12.50	15.63	6.67	0.00	7.14	31.25	9.52
NF	18.75	0.00	18.75	9.38	10.00	13.33	7.14	43.75	14.29
NG	18.75	0.00	12.50	0.00	6.67	3.33	0.00	18.75	6.55
NH	0.00	0.00	18.75	12.50	6.67	3.33	7.14	25.00	8.93
NI	12.50	14.29	12.50	3.23	0.00	0.00	14.29	25.00	7.78

Appendix 10: Results summarized by test

Participants are listed by code, with the first letter indicating Intermediate, Advanced or Native Speaker. As indicated in the text, some tests were entirely removed from consideration. All numbers are percentages.

Code	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
IA	10.71	18.75	14.29	12.50	10.00	37.50
IB	8.93	12.50	17.86	12.50	35.00	37.50
IC		21.88	17.86	18.75	15.00	25.00
ID	12.50	12.50	10.71	0.00	25.00	31.25
IE	5.36	12.50	21.43	0.00	10.00	6.25
IF	7.14	15.63	7.14	6.25	15.00	25.00
IG	12.50	18.75	10.71	18.75	20.00	25.00
IH	16.36	21.88	21.43	18.75		28.57
II	8.93	25.00	21.43	18.75	5.00	37.50
IJ	7.41	9.68	10.71	6.25	20.00	25.00
IK	56.36	25.00	21.43	0.00	15.79	31.25
IL	12.50	28.13	14.29	25.00	30.00	33.33
IM	8.93	15.63	10.71	0.00	15.00	37.50
IN	8.93	9.38	10.71	12.50	25.00	18.75
IO		12.50	10.71	12.50	50.00	43.75
IP	7.41	3.23	14.29	12.50	15.79	46.67
IQ	19.64	18.75	7.14	12.50	25.00	43.75
IR	10.91	25.00	17.86	18.75	20.00	31.25
IS	23.21	43.75	21.43	18.75	15.00	68.75
IT	17.86	6.25	7.14	12.50	15.00	31.25
AA	30.36	28.13	17.86	18.75	20.00	25.00
AB	3.70	12.50	7.14	6.25	15.00	40.00
AC	25.00	18.75	17.86	0.00	15.00	18.75
AD	3.57	6.25	10.71	0.00	30.00	31.25
AE	10.71	15.63	21.43	6.25	25.00	31.25
AF	26.79	37.50	17.86	12.50	35.00	43.75
AG	7.14	31.25	21.43	6.25	25.00	18.75
AH	7.14	25.00	10.71	31.25	21.05	40.00
AI	21.43	6.25	10.71	25.00		6.25
AJ	7.14	21.88	14.29	6.67	35.00	
AK	3.57	12.50	10.71	0.00	25.00	25.00
AL			22.22	6.25		26.67
AM	30.36	6.25	25.00	0.00	35.00	37.50
AN	33.93	25.00	38.46	18.75	45.00	43.75
AO	10.71	25.00	21.43	12.50	15.00	31.25
AP			21.43	0.00	15.00	18.75
AQ	3.57	18.75	10.71	12.50	15.00	25.00
AR	27.27	18.75	25.93	18.75	47.37	50.00
AS	10.71	18.75	17.86	12.50	30.00	18.75
AT	17.86	28.13	10.71	6.25	15.79	25.00
NA	10.71	9.38	7.14	0.00	15.00	0.00
NB	1.79	3.13	7.14	6.25	10.00	6.25
NC	12.50	15.63	10.71	6.25	35.00	0.00
ND	10.71	21.88	14.29	12.50	5.00	18.75
NE	7.14	15.63	10.71	0.00	15.00	6.25
NF	7.14	21.88	10.71	12.50	25.00	18.75
NG	3.57	12.50	10.71	12.50	0.00	0.00
NH	8.93	12.50	7.14	6.25	5.00	12.50
NI	7.14	9.68	17.86	6.25	0.00	0.00

Appendix 11: Intermediate Group Demographics

Participant code	Sex	Age	Place of Origin - Brazilian state	Accent heard most when young	Self-reported accent	Level evaluation	Eng speaking country experience	Other foreign country experience	NS audio in class	Speak other languages	Other NS of English teacher	Lusitanian Portuguese contact	Contact with elderly Riograndenses	Current level of contact w/ NS of Eng.
IA	f	22	MS	SC/PR	SC	1	2	y	1		yes	y		
IB	f	22	SC	RJ	???	1	2		0	y	Eng.	y		
IC	f	23	SC	SC	SC	1	0	y	2					
ID	f	20	SC	SC	SC	2	0		2					
IE	m	23	MG	MG	MG	2	0	y	2	y				
IF	m	22	SP	SP	SC	2	0	y	2	y				
IG	f	21	SC	SC	SC	1	0		0			y		
IH	m	15	SC	SC/SP	SC	1	0		2	y	Aust.			nr
II	m	48	SP	SP	???	0	2	y	2	y	US			
IJ	m	15	SC	RS/SC	SC	0	0	y	2			y	y	
IK	m	20	SC	German	SC	1	0		0	y				
IL	f	45	RJ	RJ/RS	RJ	0	2	y	0	y				
IM	f	21	SC	SC/RS	SC	1	0		2	y	US		y	
IN	f	23	SC	SC	SC	1	0	y	1	y		y	y	
IO	f	21	SC	SC	SC	1	0		2					
IP	m	26	BA	RS/SE	BA	1	1		0	y			y	
IQ	m	21	SP	SP	SP	1	0		2	y				
IR	m	53	SC	SC	???	1	1	y	nr	y				nr
IS	m	21	SP	SP	SP	1	0		2		Scot.			
IT	m	20	SC	SC	SC	2	0		0	y				

Brazilian state abbreviations are: BA Bahia, MG Minas Gerais, MS Mato Grosso do Sul, PR Paraná, SC Santa Catarina, SE Sergipe, SP São Paulo, RJ Rio de Janeiro, RS Rio Grande do Sul
Eng speaking country experience: 0 = none, 1 = less than 3 months, 2 = long term stay
NS audio in class: 0 = little, 1 = some, 2 = significant amount
??? in *Self-reported accent* column means *indeterminate*

Appendix 12: Advanced Group Demographics

Participant code	Sex	Age	Place of Origin	Accent heard most when young	Self-reported accent	Level evaluation	Eng Speaking Country Experience	Other foreign country experience	NS audio in class	Speak other languages	Other NS of English teacher	Lusitanian Portuguese contact	Contact with elderly Riograndenses	Current level of contact w/ NS of Eng.
AA	f	21	SC	SC	SC	1	0		0					
AB	m	20	PR	PR	PR	1	0		nr					
AC	m	25	PR	MG, Lebanese	PR	1	0	y	1	y	US			
AD	m	20	SC	RS/SC	SC	2	0	y	2	y			y	
AE	f	41	RS	RS	RS	1	0	y	0	y			y	
AF	f	22	SC	SC	SC	2	2	y	2	y	Eng.			
AG	m	24	SC	SC	SC	1	0	y	2	y			y	
AH	m	23	SC	SP	???	1	2		2		Eng.			
AI	f	23	SC	SC, German	SC	1	2		0			y		regularly
AJ	f	60	SC	SC, German	SC	0	2	y	1	y	US			
AK	m	21	SC	SC	SC	1	1	y	1	y	Aust.		y	
AL	f	65	SC	SC	SC	1	1	y	0	y	Eng.	y	y	
AM	f	22	SC	PR/RJ	SC	2	2		0		Eng.			
AN	m	30	SC	Florianópolis	SC	0	2	y	2	y	US	y	y	
AO	f	37	SC	Florianópolis	SC	1	2	y	0					
AP	m	22	SC	SC	SC	1	0	y	2	y		y	y	
AQ	f	18	SC	SP	???	2	0		2	y				
AR	f	35	SC	SC	SC	0	1	y	1	y	US	y		regularly
AS	f	48	RS	German	???	0	2	y	0	y	Scot.	y	y	regularly
AT	f	20	SC	SC	SC	1	1		2	y	Eng., NZ			regularly

Brazilian state abbreviations are: BA Bahia, MG Minas Gerais, MS Mato Grosso do Sul, PR Paraná,
SC Santa Catarina, SE Sergipe, SP São Paulo, RJ Rio de Janeiro, RS Rio Grande do Sul
Eng speaking country experience: 0 = none, 1 = less than 3 months, 2 = long term stay
NS audio in class: 0 = little, 1 = some, 2 = significant amount
??? in *Self-reported accent* column means *indeterminate*

Appendix 13: Native Speaker Group Demographics

Participant code	Sex	Age	Years in Brazil	Place of Origin
NA	f	20	1	US - Connecticut
NB	f	60	32	US - California
NC	m	40	8	UK - Manchester
ND	m	44	12	UK - London
NE	m	30	3	UK - Newcastle
NF	m	32	7	UK - London
NG	m	23	2	UK - London
NH	m	23	1	US - North Carolina
NI	f	23	2	US - Hawaii

Livros Grátis

(http://www.livrosgratis.com.br)

Milhares de Livros para Download:

Baixar livros de Literatura
Baixar livros de Literatura de Cordel
Baixar livros de Literatura Infantil
Baixar livros de Matemática
Baixar livros de Medicina
Baixar livros de Medicina Veterinária
Baixar livros de Meio Ambiente
Baixar livros de Meteorologia
Baixar Monografias e TCC
Baixar livros Multidisciplinar
Baixar livros de Música
Baixar livros de Psicologia
Baixar livros de Química
Baixar livros de Saúde Coletiva
Baixar livros de Serviço Social
Baixar livros de Sociologia
Baixar livros de Teologia
Baixar livros de Trabalho
Baixar livros de Turismo