

THE ACQUISITION OF ORTHOGRAPHIC-PHONOLOGICAL CORRESPONDENCE
RULES IN L2 AND L3 PORTUGUESE: ERROR RESOLUTION, INTERFERENCE, AND
GENERALIZABILITY

By

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To Herman O.

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LIST OF ABBREVIATIONS

< >	Indicate a grapheme
//	Indicate a phoneme
[]	Indicate an allophone
L1	First language
L2	Second language
L3	Third language
CLI	Cross-linguistic influence
FL(A)	Foreign language (acquisition)
GPCR	Grapheme-phoneme correspondence rule
IL	Interlanguage
OPM	Ontogeny-phylogeny model
SL(A)	Second language (acquisition)
T-unit	Terminal unit
U	Universals (part of the OPM)
UG	Universal grammar
VOT	Voice-onset time

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The current study investigates the acquisition of orthographic-phonological correspondence rules by learners of Portuguese as an L2 or L3, with English and Spanish as the previous language(s). Acquisition is examined from the perspectives of error resolution, interference, and generalizability. Target L2/L3 production is shown to increase throughout the course of the semester of data collection, as interference from the L1/L2 decreases. The results support previous research, finding transfer from both the L1 and L2, and interference based on language typology as well as language status. Word type (cognates, non-cognates and nonce words) is not found to play as great a role in acquisition as grapheme and participants' linguistic background. It is proposed that examination of the acquisition of orthographic-phonological correspondence rules may have the potential for highlighting more specifically the source(s) of interference in an L3.

CHAPTER 1 INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Language acquisition has long been a topic of interest in the field of linguistics, initially in the area of first language (L1) acquisition (e.g., Bloomfield, 1933; Brown, 1973; Chomsky, 1959; Skinner, 1957), and later in the area of second language (L2) acquisition (e.g., Ellis, 2008; Krashen, 1982; Selinker, 1972; White, 2003), and beyond – bilingualism (e.g., Baker, 2006; Grosjean, 2001), third language (L3) acquisition (e.g., De Angelis, 2007), and multilingualism (e.g., Aronin & Hufeisen, 2009; Cenoz, 2000; Cenoz & Genesee, 1998). Studies in acquisition have examined many different aspects of language, such as phonology (e.g., Hansen Edwards & Zampini, 2008), pragmatics (e.g., Kasper & Rose, 2002), discourse analysis (e.g., Boxer & Cohen, 2004), and so on. In examining the acquisition of an L2 or L3, the literature has often discussed the effects of a learner’s previous language(s) on the new language (e.g., Cenoz, 2003; Cenoz, Hufeisen & Jessner, 2001), and, in recent work in the area of psycholinguistics, the effects of word similarities and differences between languages, including cognates and non-cognates, have been considered (e.g., Costa, Caramazza & Sebastián-Galles, 2000; Costa, Santesteban & Caño, 2005). As far as Portuguese¹ is concerned, the language has not had the long research tradition that languages such as Spanish, French and German have had (Ornstein, 1942; Holton, 1954), but its importance as a world language has increased with the growing importance of Brazil, Latin America’s biggest economy (Margolis, 2009).

¹ Portuguese is the official language of Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal and São Tomé and Príncipe, as well as one of the official languages of East Timor, and one of the languages spoken in other areas, such as Goa and Macau. The Portuguese language ranks within the world’s top 10 most spoken languages (in terms of number of speakers), with Brazil having by far the largest number of speakers, approximated at 180 million.

The present study brings together several of these areas, as it explores an aspect of language acquisition which has not been widely discussed in the literature: orthographic-phonological correspondence rules. This study considers the acquisition of these rules by learners of Portuguese² as an L2 or L3, examining the influence of the learners' L1 (Spanish or English), and where applicable L2, on the target language, and also considering the effect of different word types (cognates, non-cognates, and nonce words) on that acquisition. It is worth mentioning that much of the literature on the acquisition of Portuguese appears to deal with impressions and observations, with relatively little empirical evidence being offered to date, making this study an important contributor in the area of Portuguese acquisition.

As is the case with many studies in language acquisition, the current research project arose as a result of classroom observations. In classes of students learning Portuguese as a foreign language, it seemed that native English speakers with high proficiency in Spanish behaved more like native Spanish speakers than native English speakers with low or no proficiency in Spanish, when it came to the treatment of certain sound-symbol correspondences. For instance, the intervocalic <s>³ in *Brasil* ("Brazil") was often pronounced as the voiceless alveolar fricative [s] rather than the voiced alveolar fricative [z], the correct pronunciation in Portuguese. While this seemed a logical approach for native Spanish speakers, whose L1 pronounces intervocalic <s> as [s] and where there is no phoneme /z/, it is not necessarily logical for native English speakers, whose L1 does have the phoneme /z/, often pronounces intervocalic <s> as [z], and has the country name (Brazil) pronounced with [z] (as required by the orthographic-phonological correspondence rule for <z> in English). It appeared that the non-native but highly proficient

² While the orthographic-phonological correspondences discussed here are the same across different varieties of Portuguese, Brazilian Portuguese is the variety taught at the institution at which the present study was carried out.

³ < > are used for orthographic representations, [] are used for allophones, and // are used for phonemes.

Spanish speakers drew on the grapheme-phoneme rules of their L2, Spanish, rather than their L1, English, when it came to the pronunciation of L3 Portuguese words containing certain orthographic-phonological correspondences, even when their L1 rules would be more helpful for the target language pronunciation.

These observations led to the overarching questions that have motivated the current study. First, to what extent are errors in foreign language pronunciation⁴ resolved over time? Second, how do the grapheme-phoneme correspondence systems of the L1 and L2 influence the acquisition of the L3 system? Third, what is the role of different word types (cognates, non-cognates, and nonce words) in the acquisition of L3 orthographic-phonological correspondence rules? In order to address these questions, it is necessary to consider the relevant research in certain key areas. First, general L2 and L3 acquisition will be discussed, including the notion of transfer, followed by a look at the acquisition of related languages, in particular Spanish and Portuguese. Next, acquisition of L2 and L3 phonology will be considered, especially as it relates to pronunciation. Thereafter, the acquisition of orthographic-phonological correspondence rules will be examined, with a presentation of the pertinent rules of English, Spanish and Portuguese for the sound-symbol correspondences considered in the current study. Finally, previous research regarding the effect of different word types (cognates, non-cognates, and nonce words) in acquisition will be considered.

1.2 L2 and L3 Acquisition

The fields of foreign language acquisition⁵ and bilingualism⁶ are well established, and research in these areas has been abundant. In the literature, numerous theories and models have

⁴ Here, production of the orthographic-phonological correspondence rules in question.

⁵ For the purpose of this dissertation, the terms “foreign language acquisition” (FLA) and “second language acquisition” (SLA or L2 acquisition) are used synonymously, when referring to a language that is learned after the first language (L1).

been proposed to account for the acquisition of a second language as a whole, or the acquisition of certain aspects of a second language (e.g., phonology), considering learners' different developmental stages and topics such as transfer from the L1 to the L2 (and vice-versa), fossilization of the L2, and achieving native-like status. It is beyond the scope of this project to exhaustively review all possible SLA theories and studies, hence the discussion here will restrict itself to those theories that are relevant to SLA insofar as L3 is concerned, or that are applicable to the current project.

One theory of language acquisition which has received a great deal of attention for both L1 and L2 acquisition is universal grammar (UG), which proposes that there are certain grammar principles, shared by all languages, that are said to be innate. Noam Chomsky has been an influential figure in this area, arguing for an innate language faculty based largely on the observed ability of L1 learners to pick up language so quickly and seemingly effortlessly, and to produce grammatically correct language despite poor input, at least insofar as negative evidence is concerned – that is, evidence of ungrammatical production in the input (see Chomsky, 1965). UG has been said to be made up of principles and parameters, where the principles are the aspects of language that all languages share (a core grammar), and parameters are the language-specific settings for these universal principles. For example, all languages have vowels but the specific vowel systems of languages such as English, Portuguese and Spanish differ.

There has also been significant discussion about what part UG plays, if any, in the acquisition of languages beyond the L1, particularly for adult learners (see White, 2003). Perspectives vary, from full access to UG during L2 acquisition at one end of the spectrum to no access to UG at the other end of the spectrum. It is beyond the scope of this dissertation to

⁶ Both simultaneous and consecutive learning of two languages is understood as bilingualism, for the purpose of this project.

review all of these perspectives; it will simply be acknowledged here that UG plays some part in L2 acquisition. Within this broad UG framework lies the Ontogeny-Phylogeny Model (OPM) proposed relatively recently by Major (2001) to describe and account for the acquisition process of the L2 and beyond. Major explained the terms ontogeny and phylogeny in both biological and linguistic terms. Biologically, he described ontogeny as the “life cycle of a single organism” (p. 81), and phylogeny as “the evolutionary development of groups of organisms” (p. 81). Linguistically, he rephrased the difference between the two with ontogeny as “the life cycle of an individual’s language” (p. 81) and phylogeny as the “life cycle of whole languages and language types” (p. 81), where the latter included “historical change, dialectal variation, language loss, and language contact phenomena” (p. 81).

In Major’s view, a model of L2 acquisition should consider the components of a learner’s interlanguage (IL), justifying the importance of each component and describing the interaction between the components. He assumed that the IL has as its components the L1, the L2 and what he calls universals (U)⁷, given the numerous studies in the literature which indicate that learners produce things which are neither part of the L1 grammar nor part of the L2 grammar (e.g., Broselow, Chen & Wang, 1998). Given these three component parts of a learner’s IL, Major described the appearance of the IL at different stages of acquisition. Initially, he claimed, the idealized learner would have an IL that is equivalent to the L1 and, finally, the IL would be equivalent to the L2. In the interim, the L1 would decrease, the L2 would increase, and U, which lay dormant initially, would increase and subsequently decrease. In addition, Major claimed that the OPM could be extended to the IL of languages learned beyond the L2 (i.e., L3, L4, L5, and

⁷Major (2001) suggests that language universals comprise UG, as well as the whole set of universal language properties: learnability theory, markedness, underlying representations, rules and processes, constraints, and stylistic variation.

so on). For an idealized L3 learner, for example, initially the IL would contain the components L1 and L2, to varying degrees depending on their stages of completion (degrees of proficiency), while finally the IL would be equivalent to the L3. Again, he claimed, U would increase and subsequently decrease.

Such a model is useful for third language acquisition and multilingualism, fields which have been drawing increasingly more attention, no doubt in part due to the realization that multilingualism is common around the world (Cenoz & Hoffman, 2003), with bi- or multilingualism being at least as frequent as monolingualism, if not more frequent (Ecke, 2001; Hammarberg, 2001). The need has thus arisen to identify specifically what distinguishes third language acquisition from second language acquisition and multilingualism from bilingualism. Clearly, while third language acquisition has much in common with second language acquisition, in terms of theoretical frameworks, for instance, there are traits which are specific to the acquisition of a third language. The increased number of linguistic systems, which entail more possibilities of combinations and interactions between linguistic systems, contribute to the complexity of third language acquisition. As well as considering the differences between L2 and L3 acquisition, this new subfield considers the influence of bilingualism on third language acquisition. Studies considering cross-linguistic phenomena, language use phenomena, and even the question of the ideal age at which third languages should be introduced in schools are some of the areas investigated within this subfield, where the L3 studied has almost always been English (Cenoz and Hoffmann, 2003).

Next, some of the differences between L2 and L3 acquisition are considered, as well as some of the effects of bilingualism on L3 acquisition. With L2 acquisition, the two languages may be acquired either consecutively or simultaneously (i.e., $L \rightarrow L2$, or Lx/Ly). When there are

three languages in play, four temporal possibilities arise: the three languages are acquired simultaneously (Lx/Ly/Lz); the first two languages are acquired simultaneously before the third language is acquired (Lx/Ly→L3); the first language is acquired before the other two are acquired simultaneously (L→Lx/Ly); or the three languages are acquired consecutively (L1→L2→L3) (Cenoz, 2003).

L3 learners, then, have more language experience to draw upon than L2 learners, as they have access to two language systems instead of one (obviously depending on the temporal nature of their acquisition process). Folk wisdom claims that it is easier for bilinguals and multilinguals to learn a new language than monolinguals, and this has been the subject of numerous studies, which have attempted to determine whether in fact bilinguals and multilinguals have an advantage over monolinguals when learning a new language. The literature is divided as to this matter. In a review by Cenoz (2003), many studies found a negative association between bilingualism and cognitive development, prior to a study conducted by Peal and Lambert (1962), in which they found that French-English bilingual children achieved higher scores on certain verbal and nonverbal tests of cognitive ability, as compared with monolingual French or English children. Cenoz (2003) reported that, since the 1960s, studies conducted to look at the effect of bilingualism on cognitive development, metalinguistic awareness and communicative skills have shown that bilinguals: 1) have higher scores in tests of creative thinking, 2) possess a higher ability to reflect on language and manipulate it, and 3) show a greater sensitivity to their interlocutors and make use of more varied communication strategies.

In reviewing the effect of bilingualism on general L3 proficiency, Cenoz (2003) reported numerous studies which showed advantages for bilinguals and several studies which did not. Nevertheless, the tendency was toward the association of bilingualism with advantages in L3

acquisition, when general L3 proficiency was considered. In one such study, Errasti (2003) looked at the effect of bilinguals' language proficiency on their L3 acquisition, studying 155 bilingual adolescents in a school in the Basque Autonomous Community in Northern Spain. Half of the students (78), classified in the maintenance group, had Basque as their L1, and used mainly Basque at home, at school and in social contexts, while the other half of the students (77), classified in the immersion group, had Spanish as their L1 or used Spanish more than Basque outside of school. (All participants had received instruction in Basque from the age of three, while Spanish was introduced into the curriculum at the age of 3, and English at the age of 8.)

For the study, participants were required to write an informal letter and a recipe in Basque, Spanish and English, over a period of three months, at monthly intervals, with the Basque materials collected first, then the Spanish, and finally the English. Materials were graded using a holistic evaluation, taking into account content, organization, language use, vocabulary, and mechanics of writing, and a T-unit⁸ evaluation, where fluency was calculated based on number of words per T-unit, grammatical complexity based on the number of clauses per T-unit, lexical complexity on the number of lexical words per T-unit, and accuracy based on the number of errors (semantic, morphosyntactic, alphabetical, and lexical) per T-unit.

In Basque, the maintenance group performed significantly better than the immersion group in all areas, which included overall production, fluency, grammatical complexity, lexical complexity, and accuracy. In English, the maintenance group again performed better than the immersion group in all areas, but this time significant differences were only found in the categories of overall production and in fluency. In Spanish, there were no statistical differences between groups in any of the categories. Considering the interaction of various factors, the

⁸ The term T-unit was coined by Hunt (1965) and is essentially the shortest grammatical unit that can stand alone (a dominant clause and its dependent clauses). It has been used to analyze discourse and writing in both the L1 and L2.

author found two interesting positive associations: 1) high levels of competence in Basque and Spanish were related to a high level of competence in L3 English; and 2) the measurements in Basque, Spanish and English, for the maintenance group, were highly correlated, suggesting that writing in each particular language was not an independent process. The first association confirmed the Threshold Hypothesis (Cummins, 1979), which stated that the students who would benefit most from their bilingualism would be those with high levels of competence in the two languages; the second association supported the Linguistic Interdependence Hypothesis (Cummins, 1979), which stated that knowledge in one language could be positively transferred to another language.

The tendency toward the association of bilingualism with advantages in L3 acquisition, when general L3 proficiency was considered, was not necessarily found to be the case when specific aspects of L3 proficiency were considered (Cenoz, 2003). Some studies in phonology (e.g., Davine, Tucker and Lambert, 1971) found no differences between bilinguals and monolinguals, while others did (e.g., Cohen, Tucker and Lambert, 1967; Enomoto, 1994). Studies in the area of syntax, morphology and the lexicon presented similar mixed results, leading to the conclusion by Cenoz (2003) that bilinguals achieved more favorable results in studies that considered general L3 proficiency rather than proficiency in very specific L3 aspects. The general suggestion, then, is that there is no negative effect of bilingualism on L3 acquisition, and that in some cases the effect is positive. The present study considers the effects of learners' previous languages on the L3 in a very specific area – the acquisition of orthographic-phonological correspondence rules – so its findings will be interesting to consider in light of the mixed results found in previous studies, insofar as advantages for bilinguals are concerned.

Another topic widely discussed in the literature on L3 acquisition is the notion of interference or transfer from the learner's L1 and L2. While this is to be expected, given a model like Major's (2001) OPM, where the beginning state of a learner's IL for the L3 is made up in part by the L1 and in part by the L2, what is perhaps of most interest is the nature of interference. Perhaps counter-intuitively, some studies have shown that during L3 production, learners often inadvertently produced L2 forms, rather than L1 forms (Dewaele, 1998; Herwig, 2001; Selinker & Baumgartner-Cohen, 1995). Faerch and Kasper (1986) suggested that these learner mistakes did not appear to be used intentionally (for instance, to bridge a lexical gap), but rather they appeared to result from the learners' inability to suppress the intrusive language.

According to a review by Murphy (2003), cross-linguistic influence⁹ has been approached in different ways in the literature. Some believe there is no significant difference between the L1 and L2 acquisition processes, claiming that errors merely result from learners' testing of hypotheses (Corder, 1967; Krashen, 1983), while others find transfer to be a natural and even necessary part of acquisition (Selinker, 1972; Gass, 1983, 1984). Murphy (2003) considered two sets of variables that could affect cross-linguistic influence (CLI): learner-based variables and language-based variables. The learner-based variables included proficiency, amount of target language exposure and use, language mode, linguistic awareness, age, educational background, and context. The list of language-based variables included language typology, frequency, word class, and morphological transfer.

Proficiency, for instance, was generally agreed to inversely influence language transfer; that is, the lower the learner's proficiency in the L2, the greater the likelihood of language

⁹ Some prefer this term to the terms transfer and interference, since it is more encompassing, including the notions that transfer may be positive as well as negative, and that transfer may be bidirectional (L1→L2, and/or L2→L1). This preference for terms does not concern the present study, thus no discrimination is made heretofore between the terms transfer, interference and cross-linguistic influence.

transfer from the L2 to the L3 (Odlin, 1989; Poullisse & Bongaerts, 1994). According to Murphy, proficiency was a prominent feature in the literature on L3 acquisition, and it was necessary to take into account the level of proficiency in all of a multilingual's languages. Hammarberg (2001), on the other hand, believed that for there to be transfer from the L2 to the L3, there must be a certain degree of proficiency in that language, while Shanon (1991) noted that the source of transfer was often the more recently acquired L2, which was weaker than the L1 in terms of proficiency.

Language exposure, Murphy pointed out, behaved similarly in the acquisition of L2 and L3: in L2 acquisition, as exposure to the L2 increased, transfer from the L1 decreased; in L3 acquisition, as exposure to the L3 increased, transfer from the L2 (and presumably the L1) decreased. This observation is consistent with Major's (2001) OPM, which has an initial IL state for the L3 as consisting of parts of the L1, parts of the L2 and universals (U), and predicts that the L1 and L2 will decrease, U will increase and then decrease, and the L3 will increase. Interestingly, Dewaele (2001) claimed that transfer from the L1 for L2 speakers declined more quickly than transfer from the L2 (and, presumably, the L1) for L3 speakers, and Murphy (2003) suggested that this might be due to the more complex linguistic system of the multilingual than the bilingual, again consistent with Major's model.

In terms of language mode, Grosjean (2001) proposed a continuum in which the "base" language (L1) was always activated, while the "guest" language (L2) became increasingly more active depending on the language mode (monolingual to bilingual). Murphy (2003) suggested that this model might be adapted for L3 learners, whose base language (L1) would always be active but whose guest languages (L2 and L3) would be active to varying degrees. She claimed that the L1 would be easier to deactivate than the L2, though this claim seemed to be

contradicted somewhat by her subsequent discussion about the typological similarity between a learner's languages. Language typology is explored later in this chapter, in section 1.2.1.

Another way of accounting for these "intrusions" from one non-native language (L2) into another (L3) was put forwards by De Angelis (2005), who proposed a cognitive process by which learners transfer lexical items from one non-native language to another without being aware of it, calling such a process a "system shift." She suggested that such a shift might occur in three stages: 1) first, the learner transfers a lexical item from one non-native language to another (presumably due to a knowledge gap), believing that the item belongs to the source system only; 2) next, the learner associates the lexical item with the guest system, believing that it may belong in both the guest system and the source system; and 3) the learner believes the lexical item belongs to the guest system, no longer recognizing the source of her knowledge as being found in the source system. The first stage has been widely discussed in the literature, and could certainly be attested to by any foreign language instructor.

The hypothesized second and third stages were tested in three separate studies conducted by De Angelis (2005). In the first study, a French-Canadian speaker of Italian, with previous knowledge of English and Spanish, was interviewed in Italian about her personal experiences in London and other foreign countries. Her interview was analyzed for instances of CLI from French or Spanish. Six months after the initial data collection, the participant was interviewed again, about the specific problematic lexical items. The participant was first asked if she was familiar with the English words (read to her one at a time), and then she was asked to translate them into Italian. Afterwards, the participant was asked if she was familiar with the correct target Italian words. For the 12 troublesome lexical items identified, the participant produced a Spanish or Spanish-influenced word at both interviews on eight occasions. Most of the 12 words shared

similar forms in Spanish and Italian, which might account for the overt lexical transfer from Spanish, although in some cases the participant produced a Spanish-Italian blend, suggesting previous familiarity with the correct Italian word. De Angelis (2005) suggested that this provided some support for the notion that the participant believed she was producing an Italian word, leading the researcher to question whether in some cases learners are even aware of the source of their knowledge in the original linguistic system.

In the second study, De Angelis' (2005) participants were 10 L1 English university students, with low proficiency in Spanish, enrolled in Italian language classes (of different levels). The learners were given a list of English words to be translated into Spanish (all non-cognates in English, Spanish and Italian), followed by a text in English to be summarized in writing in Italian, followed by the same list of English words, this time to be translated into Italian. (Participants were asked not to look at previous sections after completion, and were carefully monitored to ensure compliance.) Results showed learners providing a Spanish word in the Italian translation task, in some cases, but then failing to provide a translation for the same item in the Italian translation task, and vice-versa, suggesting a lack of knowledge concerning the original source system. In her third study, De Angelis (2005) had an L1 English speaker, with previous knowledge of Italian and Spanish (as well as Latin, French and German), keep a diary of those things which confused him most about learning and having to speak two non-native languages.¹⁰ The diary illustrated the participant's struggles in keeping the two languages separate, with instances where he knew the words in both languages but didn't know to which language a word belonged.

¹⁰ The researcher had been approached by the participant, who was reporting some confusion between Spanish and Italian. He was living in Spain and studying Spanish and Italian, having previously learned Italian informally while living in Italy.

De Angelis (2005) suggested two factors that might lead a learner to effect a system shift: 1) what she called “perception of correctness” (p. 11), where a learner quite easily perceives that words in the native language are not correct target language words, and thus is able to block transfer of these words, while less easily blocking transfer of words from another non-native language which learners perceive to be correct (depending, of course, on levels of proficiency in the non-native languages); and 2) “association of foreignness” (p. 11), where a learner comes to associate (all) non-native languages as foreign, creating a cognitive link between the foreign languages which does not exist between the native language and a foreign language. De Angelis believed that these two factors might help to explain why L3 learners have been observed to block transfer from their L1 in favor of transfer from another non-native language.

The present study considers the nature of interference (from the L1 and/or the L2) by examining the production of orthographic-phonological correspondences in the L3 by learners with different linguistic backgrounds (L1 English with L2 Spanish, and vice-versa), and of differing levels of proficiency in the L2. The results will be interesting to compare with those observations outlined above, to see where the intrusions are coming from (i.e., the L1, a more proficient L2, or a less proficient L2). Despite differing views as to how “intrusions” end up being part of a non-native language – be they from another non-native language or from the native language; be they due to low or high proficiency in a non-native language – cross-linguistic influence is undeniable, especially in the case of similar languages (Carvalho, 2002). For this reason, it is important to consider now what the literature has noted with regard to related languages.

1.2.1 Acquisition of Typologically Similar Languages

Language typology is a rather broad term which refers to language classification, and there are many ways in which to classify languages (Fromkin, Rodman & Hyams, 2007). Syntactic

typology, for one, considers word order in a particular language or group of languages, such that languages with subject-verb-object (SVO) word order (e.g., English, Spanish, and Portuguese) would be considered typologically similar to each other but different from languages with, for example, subject-object-verb (SOV) word order (e.g., German, Dutch, and Japanese). From a phonological perspective, typology may refer to the syllable structure permissible within a language: from a simple consonant-vowel (CV) and vowel (V) structure (e.g., Japanese) to more complex structures including consonant clusters at the beginning and end of syllables (e.g., English, Spanish, and Portuguese). Typology may also refer to the origin of a language, or the family to which a language belongs. For instance, Spanish and Portuguese are derived from Latin, while English, German and Swedish are derived from an earlier form of Germanic known as Proto-Germanic (Fromkin, Rodman & Hyams, 2007).

With regard to the effect of language typology on the acquisition of L2 and L3, it seems that similar typology is often advantageous, being a source of facilitation or positive transfer. Considering similarities due to language family, Orr (1987, as cited by Jarvis & Odlin, 2000) looked at the acquisition of prefixation in Chichewa, a Bantu language, and found an advantage for L1 speakers of Ngoni, another Bantu language, compared with learners of Chichewa with Gujarati as their L1, an Indo-European language that does not have the same Bantu prefixing system.

Considering languages that were related (and unrelated) in their morphological structures, Jarvis and Odlin (2000) examined L1 Finnish and L1 Swedish learners of English as an L2, in their use or non-use of prepositions with the verbs *take*, *sit* and *put*, in a task where they were asked to write a narrative for a short silent film they had just watched. Swedish and English were considered typologically similar in this study, with regard to their free, prepositional

morphology, while Finnish was considered typologically dissimilar, with bound, agglutinative morphology for spatial references. The authors found that learners with the typologically dissimilar L1, Finnish, omitted prepositions in English in all of the spatial contexts examined, while those learners with the typologically similar L1, Swedish, did not omit English prepositions in any of the contexts.

Cenoz (2001) also found evidence of greater cross-linguistic influence between L2/L3 English and a typologically similar L1 or L2 than a dissimilar one. In a study of L1 Basque and/or L1 Spanish elementary and secondary school children learning English¹¹, using a story-telling task in English, Cenoz found greater transfer from Spanish, an Indo-European language like English, than from Basque, a non-Indo-European language. These studies suggest more positive cross-linguistic influence when the L1 is typologically similar to the L2.

Studies considering the effect of the typological similarity or dissimilarity of an L1 and L2 on the L3 have shown mixed results. On the one hand, facilitation has been found between an L2 and L3 when they were typologically similar. For instance, Ecke and Hall (2000, as cited in Ecke, 2001) found that L1 Spanish speakers with L2 English and L3 German had much stronger influence from the L2 than from the L1 in written production of the L3. In other cases, no facilitation was found between typologically similar languages. For example, in a study of German prepositional verbs, where participants had a variety of L1, L2, L3 and sometimes L4 backgrounds, Gibson, Hufeisen and Libben (2001) examined the effect of similar and dissimilar previous languages on learners' production of German prepositions in a fill-in-the-blank task¹².

Gibson et al. found that those participants with L1s structurally similar to German did not

¹¹ All participants were native speakers of Basque and/or Spanish, had Basque as the language of instruction at school, and had Spanish and English as school subjects.

¹² Verbs were given and participants had to supply the following preposition. For example, *gehören zu* ("belong to"), and *sprechen über* ("talk about").

perform differently from those with structurally dissimilar L1s, nor did having English as a foreign language help German learners, even when the German preposition would be a translation equivalent of English.

The current study considers Spanish and Portuguese, two languages which are closely related in terms of language family, many structural aspects and lexical items. In the case of these two languages, most of the literature would agree that knowledge of one language generally facilitates the acquisition of the other language, although it may also prove to be a hindrance in some respects. To follow is a review of the literature that considers the relatedness of these two languages.

1.2.2 The Relatedness of Spanish and Portuguese

Garrison (1979) highlighted the similarities between Spanish and Portuguese, observing that there are few languages as closely related, and that there are fundamental similarities that transcend even regional dialects of the two languages. In an overview of a presentation on Portuguese given to Advanced Spanish students, he suggested that around 80% of Portuguese words have Spanish cognates, going on to point out some of the systematic differences between Spanish and Portuguese orthography (e.g., the grapheme <ç> which exists in Portuguese but not in Spanish), phonology (e.g., nasal vowels in Portuguese, Portuguese monophthongs for certain Spanish diphthongs), lexical items in the form of non-cognates (e.g., “street” is *calle* in Spanish and *rua* in Portuguese) and false cognates (e.g., *apellido* is Spanish for “last name” while *apelido* is Portuguese for “nickname”), and grammatical items, such as gender differences on nouns (e.g., masculine *mensaje* in Spanish and feminine *mensagem* in Portuguese, “message”), verb conjugations (e.g., the first person singular conjugation of the verb *poder*, “to be able to,” is *puedo* in Spanish and *posso* in Portuguese), verb tenses (e.g., Spanish does not have the personal (conjugated) infinitive that Portuguese has), and so on.

Holton (1954) also highlighted the relatedness of Spanish and Portuguese. In an effort to promote the great literary works in the Portuguese language, he suggested that Spanish speakers might easily learn to read Portuguese with minimum effort, given an understanding of certain basic differences between the two languages. He delineated some of the orthographic and phonological differences between Spanish and Portuguese, as well as some grammatical differences (focusing on articles, verbs and pronouns), with the intent of showing how simple it would be for a Spanish speaker to develop a recognition skill like reading. He clarified that such a method would not suffice for the acquisition of an active command of the language, highlighting that speaking and comprehension of spoken Portuguese would require a more concerted effort. Nonetheless, the fact remains that the languages do share considerable structural and lexical similarities.

Resnick (1945) illustrated the advantages and disadvantages of having a background in Spanish when learning Portuguese by listing examples of words which are cognates, non-cognates and false cognates in the two languages. He also highlighted that cognates (including false cognates) often differ in the languages in terms of spelling and pronunciation, something which learners must bear in mind during the acquisition process.

Azevedo (1978) observed that university students acquainted with one language (Spanish) experienced facilitation in the acquisition of a new language (Portuguese) due to the structural similarities between the two languages, yet at the same time, these precise similarities often caused problems for the learners, leading to transfer of several Spanish features, such as morphological, phonological, lexical and syntactic markers, which did not belong in Portuguese. In terms of phonological errors, Azevedo specifically pointed out, among other things, the feature under investigation here: the tendency of Spanish speakers to devoice the voiced alveolar

fricative [z] in Spanish-Portuguese cognates like *zero* (“zero”) and *casa* (“house”). Additionally, Azevedo highlighted the fact that although Portuguese instructors might be aware of Spanish interference, it was difficult for them to correct the problem, “...because the diagnosis of the problem is done, more often than not, in an impressionistic and unsystematic manner” (p. 19), rather than being based on empirical evidence, thus highlighting the need for further research on learners’ production in order to enable targeted correction strategies.

Tarquinio (1977) also mentioned some of the difficulties with pronunciation that arise for learners of Portuguese. As a native Brazilian Portuguese speaker and an instructor of Portuguese and Spanish, she was particularly attuned to common pronunciation mistakes which resulted from interference (particularly from Spanish), including the devoicing of the intervocalic <s>, which is voiced in Portuguese. She went so far as to state that these “interferences hurt the ears of the native listener because they are foreign” (p. 82), and suggested that students be alerted early on as to these common interferences, by explicitly drawing their attention to them.

While much of the literature on Spanish and Portuguese highlights the mutual intelligibility of the two languages, there are those who maintain that the spoken languages are quite different in pronunciation, resulting in reduced understanding, particularly for Spanish speakers trying to understand Portuguese (Ellison & Andrews, 1969; Jebson and Biel, 1986; Timberlake, 1989). These observations about the similarity between the two languages, or lack thereof, prompted Jensen (1989) to conduct a study looking at extent and direction of intelligibility, as well as the effect of certain non-linguistic factors (age, sex, education, attitude and experience with the other languages). Thirty-nine native speakers of Portuguese listened to four recorded texts read in Spanish, while 32 native speakers of Spanish listened to four recorded

texts read in Portuguese.¹³ Each group had to answer five multiple-choice comprehension questions per text, written in their native language, and complete a short questionnaire asking about the non-linguistic factors considered by the study. The native Portuguese speakers performed significantly better than the native Spanish speakers on three of the four texts; the text on which native Spanish speakers performed better than native Portuguese speakers related to Ecuador, and it was postulated that the Spanish speakers, all of whom were from Latin America, might have had more familiarity with the subject than the Portuguese speakers, all of whom were from Brazil. Of the non-linguistic factors, the only one found to significantly and positively affect participants' scores was experience with the other language, which came as no great surprise. In this study of passive listening to recorded voices, Jensen found Spanish and Portuguese to be mutually intelligible, but only at a level of about 50% to 60%. Additionally, the results supported the common belief that Portuguese speakers understand spoken Spanish better than Spanish speakers understand spoken Portuguese, although the difference was not staggering, and might be attributable to individual factors.

Jordan (1991) described the differences between Spanish and Portuguese as mainly morphological and phonological, as she made a case for the use of a contrastive method in the teaching of Portuguese to speakers of Spanish (or, presumably, vice-versa). Jordan claimed that there is little point in a contrastive course if the goal is simply for speakers to understand each other and make themselves understood, since these two tasks are achieved relatively effortlessly with little or no instruction in the other language (see Jensen, 1989). However, for a speaker to reach a certain level of proficiency in writing and speaking the non-native language, Jordan suggested the use of a contrastive method, highlighting the basic phonological and

¹³ Participants with "extensive experience of the other language" (p. 850) or who were of "foreign (e.g., European, Asian or North American) background" (p. 850) were eliminated from analysis.

morphological differences, and particularly the few exceptions to the general rule. Given that learners would make comparisons between the languages anyway, Jordan believed that it would be helpful to make this process a conscious one, thereby limiting the erroneous assumptions and generalizations that students might make. In a qualitative examination of a class of Spanish speakers learning Portuguese, where she used a reference book designed to cover the principal phonological and morphological differences between the two languages (making no mention of similarities), Jordan found that students concentrated on certain differences while having problems with other discrepancies, one of which was the intervocalic <s> which was often not voiced. To overcome these problems, Jordan suggested the need for increased exposure to the non-native language, particularly in the areas of listening and reading, and also for as much communication as possible to be in the target language in the classroom, in order that learners might overcome the fear of making mistakes.

Carvalho (2002) discussed the inevitability of transfer, in particular from a known language to a similar language being learned, where this transfer might be positive or negative. In the case of Spanish and Portuguese, where there is a high degree of mutual intelligibility¹⁴ even between monolingual speakers of the two languages, a primary concern of instruction is early fossilization. Where learners are able to achieve a high level of communicative ability early on, Hadley (1986) stated that “fossilization is more likely to occur if learners see no reason to improve their interim grammar and decide that it is adequate to serve its needs” (p. 268). Thus, Carvalho (2002) claimed that instruction for speakers of a typologically similar language must include activities which emphasize grammatical correction and promote metalinguistic

¹⁴ Jensen (1989) found this to be approximately 50-60% in a recorded listening task, but Carvalho (2002) suggested that this percentage might be higher in a conversational setting, where speakers could negotiate meaning and make use of visual cues.

reflection, and she called for further studies to contribute empirical data which might reveal and contrast different stages involved in the acquisition of Portuguese by Spanish speakers.

In this section, particular consideration has been given to the relatedness between Spanish and Portuguese, and it has been noted that phonological differences between these two languages often pose problems for learners. The current study considers the role that the typology of learners' previous languages plays in the acquisition of the L3, as it examines interference from English and Spanish in participants' production of Portuguese. Here, Spanish is considered to be closer to Portuguese (more typologically similar) than English, given the language family, structural aspects and lexical items that Spanish and Portuguese share. In the next section, the acquisition of L2 and L3 phonology will be discussed, specifically as it relates to the acquisition of pronunciation.

1.2.3 Acquisition of L2 and L3 Phonology

In some of the earlier approaches to second and foreign language pedagogy, pronunciation and oral skills in general were not stressed as highly as listening skills (Lazaraton, 2001). With the advent of more communicative approaches, the importance of speaking has increased, although focus on pronunciation has still been somewhat lacking. Blanche (2004) noted that the Communicative Approach does not concern itself so much with accent reduction as with "intelligibility" (p. 178), and Keys (2000) stated that this approach "encouraged a tendency to leave pronunciation matters to one side" (p. 91). Goodwin (2001) described pronunciation as a critical element because it is "the language feature that most readily identifies speakers as non-native" (p. 117). Poor pronunciation, as perceived by native speakers, may result in the non-native speaker feeling embarrassed and inferior (Goodwin, 2001), while "good" pronunciation in a foreign language does not draw the attention of a native speaker away from what is being said to how it is being said (Hockett, 1950).

While the place of pronunciation in pedagogy may be debatable, it is clear that pronunciation poses problems for many learners (e.g., with relation to the acquisition of Portuguese pronunciation, see Azevedo, 1978; Tarquinio, 1977; Jordan, 1991), and as such, pronunciation is an area of FL acquisition which has led to many studies exploring the nature of production. It is beyond the scope of this dissertation to review exhaustively the studies which have looked at the acquisition of L2 and L3 phonology, since much of the work which has been carried out in these fields is, at best, only tangentially related to the present study, which looks at the role of orthography in the acquisition of pronunciation. (For a review of theoretical approaches to phonology and current trends in L2 phonology see Major, 2001, 2008, and Hansen Edwards and Zampini, 2008.) However, by way of example, a few of the studies which have examined the influence of learners' previous language(s) on their acquisition of pronunciation will be presented here.

Major (2001) states that there has been much research done in L2 phonology looking at claims (from Contrastive Analysis) that similar phenomena are more difficult to learn than dissimilar phenomena, with the psycholinguistic reason for this seeming to lie in the fact that "gross differences are more often noticed, due to perceptual saliency, [than] minimal differences" (p. 37). Flege (1986) stated that, given the L1 as a starting point for the L2, learners could categorize L2 phones into three categories: "identical," "similar," and "new." "New" phones in the L2 are those which have no counterpart in the L1; "similar" phones are those where the sounds in the L1 and L2 are acoustically similar but not exactly the same; "identical" phones are those which share all acoustic properties in the two languages. Flege (1987) hypothesized that "new" phones in the L2, with no counterpart in the L1, would be easier to

acquire than “similar” phones, with a counterpart in the L1 that differed phonetically in some minimal way.

In his study, Flege (1987) examined Voice Onset Time (VOT) in the production of “similar” phones (/u/ and /t/) and a “new” phone (/y/) by bilingual English-French speakers and monolingual English and French speakers. His participants included: 1) French and English monolinguals (to provide an idea of phonetic “norms” in the two languages), 2) three groups of American English speakers who had learned French as adolescents or young adults (the groups differed in their level of proficiency in French), and 3) French speakers who were highly proficient in English. Participants carried out two tasks, both based on lists of phrases provided in French and English, containing /tu/ and /ti/ in English (*two* and *TV*), and /tu/ and /ty/ in French (*tous* – “all” – and *tu* – “you”). In the first task, participants simply read the lists of phrases; in the second task, they were required to produce original, complete sentences based on the phrases they had just read in isolation. Results for /t/ production showed that the greater the learners’ proficiency in L2 French, the closer their production was to that of French monolinguals, both for English /t/ and French /t/. The group of L1 English speakers highly proficient in French produced English /t/ intermediate to the norms of the L1 and L2. Similarly, the group of French speakers highly proficient in English produced both English and French /t/ intermediate to the norms of English and French. These results seemed to suggest that the greater the experience in two languages, the less difference there is between the L1 and the L2 forms. As for /u/ production, the L1 English speakers consistently produced English /u/ similarly to monolingual English speakers. However, the L1 French speakers failed to produce French /u/ according to the norm set by the French monolinguals. Thus, learning French did not appear to affect the English speakers’ production of L1 /u/, but learning English did affect the French speakers’ production of

L1 /u/. Finally, for /y/ production, only the group of English speakers with the lowest level of proficiency in French differed significantly from the group of French monolinguals. This result showed that, with the “new” phone (/y/), where there was no possibility of an approximation to an English (L1) counterpart, the learners of French were able to come close to producing an authentic L2 sound.

Baker and Trofimovich (2005) examined groups of L1 Korean speakers learning English as an L2 (children and adults), in order to determine how age of acquisition influenced the organization of learners’ phonetic systems. The researchers carried out a picture-naming task to elicit six English vowels in 18 CVC monosyllabic words and five Korean vowels in 10 disyllabic words, first collecting baseline data from monolingual Korean children and adults, and monolingual English children and adults, then collecting data from the L1 Korean speakers learning English as an L2, with the latter participants being divided into early bilinguals (those who learned the L2 before the age of 15) and late bilinguals (those learning the L2 after the age of 15). Analyzing the production data acoustically, the researchers compared the production of the bilinguals with that of the monolinguals, as well as comparing the production of the early bilinguals with that of the late bilinguals. Results showed that early bilinguals produced different acoustic realizations of the English and Korean vowels, while late bilinguals produced English vowels that were often “colored” by the L1. In fact, the more acoustically similar the vowels in the L1 and L2 were, the more likely the “coloring” of the L2 vowels by the acoustic properties of the L1 vowels, such that late bilinguals only produced acoustically different sounds when the L1-L2 pairs of sounds were very different. The researchers also observed that length of exposure to the L2 in late bilinguals was significant, in that learners tended to produce L2 sounds as L1 sounds more in the early stages of acquisition than in later stages of acquisition.

Wade-Woolley (1999) observed that a learner's L1 phonological system constrained the learner's ability to perceive and produce sounds in the L2, citing several studies to illustrate this point: 1) a study by Werker and Tees (1984) showed L1 English speakers' inability to distinguish between Hindi dental and retroflex stops, since this distinction does not exist in English; and 2) studies by Goto (1971) and Yamada & Tohkura (1992) showed L1 Japanese speakers learning English having problems with the /l-/r/ contrast which exists in the L2 but not in the L1.

It is clear from these studies that L1 phonology has a considerable role to play in L2 phonology, and transfer from a learner's previous language is an important factor to consider in the acquisition of L2 pronunciation. Further, Muller and Muller (1968) observe that transfer is particularly problematic when a written stimulus is used to evoke an oral response. Thus, it is important to take the written form into account in the discussion of the acquisition of pronunciation. The correspondence between orthography and phonology is at the heart of the present study, and the acquisition of such correspondence rules will be discussed next.

1.3 Acquisition of L2 and L3 Orthographic-Phonological Correspondence Rules

In the field of L2 and L3 acquisition, few studies have focused on the relationship between orthography and phonology, and more specifically how acquisition of the two is influenced by a learner's previous language(s). This area merits further attention, however, because sound-symbol correspondences are important not only for effective reading and writing skills, but they can also relate to good pronunciation (Olshtain, 2001). Many studies looking at the relationship between orthography and phonology have focused on English as an L2 or L3 and concentrated on differences arising as a result of different L1 scripts, that is, alphabetic and non-alphabetic scripts.

Koda (1999) described orthographic structures as varying along two dimensions: 1) the fundamental unit of orthographic representation, and 2) the depth of representation. The basic unit of representation in alphabets is the phoneme, while the morpheme is the basic unit in logographies. With alphabets, readers must systematically analyze component letters and letter clusters within a word, and reading competence requires that readers realize that written symbols correspond to speech units. With logographies, it has been argued that readers arrive at phonological information through whole-word lexical retrieval rather than through word-internal analysis (Gleitman, 1985). Orthographic depth, the second dimension described by Koda, relates to the degree of regularity found in sound-symbol correspondences. Shallow orthographies, like Spanish and Portuguese, have a high degree of orthographic-phonological regularity, while deep orthographies, such as English, have much less consistent correspondences, as evidenced by the orthographically similar yet phonologically dissimilar related words *anxious* and *anxiety*.

With these differences in mind, Koda (1999) examined adult learners of L2 English, and explored the effect of different L1 backgrounds (alphabetic and logographic) on the learners' intraword sensitivity. The study's participants were 20 native speakers of Chinese, chosen because of their experience with a logographic script, and 20 native speakers of Korean, selected because of their experience with the non-Roman alphabetic script Hangeul. The two groups were comparable in terms of their length of stay in the US (less than 6 months), the type and length of instruction they had had in English in their own countries (grammar/reading methods in high school), and their scores on listening and reading sections of the Test of English as a Foreign Language (TOEFL).

The participants completed two tasks: an orthographic acceptability judgment task and two decoding tasks. For the first task, a series of 40 nonsense words were created by rearranging real

words, such as “double” and “report”, to yield legal strings (according to English phonotactic rules) like “boudel” and “troper,” as well as illegal strings such as “ebdluo” and “tproer.” Participants were asked to judge the orthographic acceptability of these nonsense words, being allowed to spend as much time as necessary on the test.¹⁵ For the second task, two decoding activities were used. The first required that participants read aloud 50 pseudo-English words, with some allowance being made for certain non-native pronunciation (such as devoicing of final /b/ by Korean speakers). The second decoding task was a homophone judgment test, where 30 real English words were presented visually paired with orthographically legal strings, with half of the pairs being homophonic (e.g., “please”- “pleeze”) and half non-homophonic (e.g., “dream”- “drain”). Participants indicated their judgment of these pairs, by circling S for same or D for different. It was predicted that the Korean learners, given their experience with another orthographic script and ensuing intraword sensitivity, would outperform the Chinese learners on both tests. In fact, the Korean learners did outperform the Chinese learners in the orthographic acceptability test on those nonsense words with illegal strings, suggesting that their L1 intraword sensitivity might have been extended to their L2. However, there were no significant differences between learners on the decoding tests, possibly resulting from the fact that English has two representational properties for its orthography – morphemes and phonemes. Koda suggested that learners using logographic strategies might have had less success with a phonologically shallow orthography, an observation requiring empirical testing.

Wade-Woolley (1999) also examined the orthographic and phonological effects of different L1 scripts on word reading in the L2, in a study of L1 Russian and L1 Japanese learners of English as an L2. Participants undertook seven tasks which included a mixture of standardized

¹⁵ Presumably, Koda used the term “orthographic acceptability” to refer to phonotactic acceptability, since the illegal strings violate English phonotactic rules rather than, specifically, orthographic rules.

and experimental tests involving reading comprehension and vocabulary, reading of isolated words (previously seen and unseen), matching of aural stimuli with a correctly spelled word, distinguishing between visually similar (phonotactically permissible and non-permissible) English pseudo words, repetition of aurally presented pseudo words, and phoneme deletion. Japanese learners were found to perform better on tasks which required recognition of correct or permissible orthography (real and pseudo words, respectively), while Russian learners performed better on the phoneme deletion task. These results suggested that Japanese learners relied less on phonology than orthography in reading, as the researcher had anticipated, due to the learners' non-alphabetic L1, lending support to the idea that there are transfer effects to be found in L2 reading.

Relatively few studies have dealt specifically with the acquisition of Portuguese pronunciation, and particularly as it relates to orthography. One such study was conducted by Defior, Martos and Cary (2002), who examined children learning to read in their L1 Portuguese or Spanish. Although both of these languages are considered to have shallow orthographies¹⁶, the grapheme-phoneme correspondence rules (GPCRs) in Portuguese are less consistent than those in Spanish. In their study, Defior et al. (2002) examined the extent to which differences between the two orthographies impacted reading strategies, where these were divided into two types: 1) phonological, sublexical, or indirect; and 2) visual, lexical, or direct. (Strategies of the first type relied more on GPCRs to assemble the pronunciation of lexical items while strategies of the second type required a reader to use direct access to the lexicon in order to retrieve an item's pronunciation.) Given the greater asymmetry and complexity in Portuguese than in Spanish, the authors hypothesized that Spanish children would perform better (i.e., faster and with greater

¹⁶ In a shallow orthography, the grapheme-phoneme correspondence rules (GPCRs) have highly consistent rules, while the GPCRs in a deep orthography, such as English, have inconsistent and unpredictable rules.

accuracy) than Portuguese children on nonce words. In their experiment with 120 Spanish and 94 Portuguese children in grades one through four, participants read a list of numerals (2, 3, 4, etc.), number words (*dois, três, quatro*¹⁷, etc.), and nonce words (*nois, nês, datro*, etc.). Errors were divided into two types, in order to disclose different types of reading strategies (i.e., indirect phonological vs. direct lexical): 1) phonological errors, where deletion, substitution or some other inversion of consonants and/or vowels led to the production of another nonce word; and 2) lexical errors, where errors led to the production of a real word. Thus, phonological errors were indicative of a failure in the use of the indirect phonological strategy, while lexical errors reflected a failure in the use of the direct, lexical strategy.

Across all grades and both orthographies, participants were significantly slower with nonce words than with numerals and number words. Additionally, results confirmed the authors' hypothesis, as the Portuguese children were slower with nonce words than the Spanish children. Spanish children also read number words faster than Portuguese children, but there were no significant differences found between the two orthographies with numerals. In terms of errors, there were no significant differences found between grades or orthographies for numerals or number words. The pattern of errors in reading nonce words was different for the two orthographies: Portuguese children steadily decreased in number of errors from grades one to three, while Spanish children maintained a stable rate of errors from grade two on. Additionally, Portuguese children made significantly more phonological errors than Spanish children (except at grade three). Spanish children also made fewer lexical errors initially than Portuguese children, although this distinction disappeared in grade two, only to reappear in grade four, where Portuguese children made fewer lexical errors than Spanish children. The increase in

¹⁷ *Dois* ("two"), *três* ("three"), *quatro* ("four"), etc.

lexical errors between grades three and four, found for both orthographies, might be indicative of a change in reading strategies: in grade three, Spanish and Portuguese children might be turning from an indirect, phonological strategy to a direct, lexical one. In summary, the participants generally performed better on numerals and number words than nonce words, and the children with the simpler orthography (Spanish) performed better on nonce words than those with the more complex orthography (Portuguese).

Muller and Muller (1968) also examined the influence of orthography on the acquisition of pronunciation in Portuguese, but with L2 learners rather than L1 learners. In their study of 140 high school students receiving instruction in Portuguese, they considered: 1) whether the exposure of the written form interfered with the acquisition of pronunciation; and if so, 2) which letters or letter combinations were most likely to cause interference. Participants were divided into two groups: those who were denied access to the written form during the first four weeks of instruction in Portuguese, and those who were allowed access to the written form but without explicit instruction on the relationship between orthography and phonology. After four weeks of instruction, participants were given picture cue sheets and asked to produce sentences which had formed part of drill materials used during the instruction phase. The participant utterances were recorded and later listened to and judged by raters who were both native speakers of Portuguese and language instructors, using a three-point scale¹⁸. Results indicated that the group of participants who had had access to written materials performed significantly worse than the group which was denied access to the written form, suggesting that the written form had indeed interfered with the acquisition of pronunciation.

¹⁸ The criteria for judging the participants' production items (sentences) are not included by the authors, thus it is not possible to know whether assessment was global or specific. However, given that the authors go on to postulate about GPCRs, it would seem that assessment of specific sounds would be necessary in order to allow an informed discussion of those GPCRs which were found to be most problematic for their participants.

The researchers then considered, in abstract terms, possible combinations of grapheme-phoneme correspondences in English and their correspondents in a target language, and predicted that the most logical source of interference would be when a grapheme A in both languages represented a phoneme X in one language and (an entirely different) phoneme Y in the target language. Considering this specific permutation – AX AY – in their data, the researchers found that the participants who had been denied access to the written form performed significantly better than those who had been allowed access to the written form. This suggested evidence of interference due to the difference in pronunciation of the same grapheme in the two languages.

The present study explores the nature of interference in the case of this same orthographic-phonological permutation, where a single grapheme represents different phonemes in different languages, by considering how L1 English/L2 Spanish and L1 Spanish/L2 English speakers treat the graphemes <s> and <z> in L3 Portuguese. As previously mentioned, the typological similarity between Spanish and Portuguese is at once an asset and a liability (Resnick, 1945), with the differences in GPCRs facilitating certain phonological combinations but leading to continued mispronunciations by learners in other cases (Jordan, 1991). Examining the sound-symbol correspondence systems in English, Portuguese and Spanish for the GPCRs considered in the present study will highlight the similarities and differences between the three languages.

1.4 The Relevant Rules of English, Spanish and Portuguese

Two orthographic symbols are considered in the present study: <z> and intervocalic <s>¹⁹. In Portuguese, both of these graphemes are pronounced as [z] (Table 1-1). In Portuguese, there is

¹⁹ It was originally intended that the study examine six sound-symbol correspondences – <z>-[z], intervocalic <s>-[z], <j>-[ʒ], <ge/gi>-[ʒ], <rr>-[h], and word-initial <r>-[h] (Faraco & Moura, 1990) – and data were collected with this objective in mind. However, due to the complexity of the project, this dissertation will examine only the first

not always a one-to-one correspondence between graphemes and phonemes. In the case of the two graphemes considered in this study, <z> has a one-to-one grapheme-phoneme correspondence but <s> does not. The grapheme <z> is always pronounced as [z]. The grapheme <s> has two possible pronunciations: 1) [s] word-initially, and after consonants <l, n, r>; and 2) [z] in intervocalic position and before voiced consonants (Table 1-2). It is worth mentioning that [s] exists between vowels, but with a change in the orthography, from <s> to <ss>. This orthographic change (with accompanying phonological change) is phonemic, resulting in a change in meaning, as demonstrated by the minimal pairs *asa* ([aza], “wing”), and *assa* ([asa], “s/he bakes”). The orthographic-phonological correspondence rule <ss>-[s] was not considered in the present study, however, as the aim was to consider the phoneme /z/ and its two orthographic correspondences, <z> and intervocalic <s>²⁰.

The sound-symbol correspondences in English and Spanish are rather different from those in Portuguese, for the two orthographic symbols considered in the present study. It is important to understand these differences, in order to be able to discuss later the effect of English and Spanish on the acquisition of the Portuguese correspondences. Where Portuguese has [z] for <z> and intervocalic <s>, Spanish has a different sound from Portuguese, but the same sound for both graphemes: [s]²¹ (Table 1-3). The English sound-symbol correspondences for the graphemes

two correspondences. While the chapter on methodology will make mention of the other four correspondences, the results and discussion chapters will consider only the <z>-[z] and <s>-[z] correspondences.

²⁰ It is worth noting that the phoneme /z/ is represented orthographically not only by <z> and intervocalic <s>, but also by <s> before voiced consonants (as mentioned previously), and by <x>, in words such as *exemplo* (“example”) and *exame* (“exam”). However, <x> is not considered in the present study due to its irregularity of pronunciation, since it can also be pronounced as [s], as in *excelente* (“excellent”) and *excesso* (“excess”), and as the voiceless palatal fricative [ç] in words such as *caixa* (“box”) and *xícara* (“cup”).

²¹ While this may not hold true for Castilian Spanish, where <z> is pronounced as [θ], it is true for most varieties of Spanish. Additionally, it is noteworthy that Spanish has no voiced alveolar fricative phoneme /z/, although there is the possibility that speakers may realize orthographic <s> as [z] when it occurs before certain voiced consonants, as in *mismo* (“same”), *asno* (“donkey”), and *desde* (“since”), although speakers may not be aware of the sounds they produce (Schwegler & Kempff, 2007).

examined in the current study differ slightly from those in both Spanish and Portuguese. In English, <z> is pronounced as [z], as it is in Portuguese. The intervocalic grapheme <s>, however, has three possible pronunciations in English: [z], [s], and the voiced palatal fricative [ʒ] (Table 1-4). In the current study, the effect of these different orthographic-phonological correspondence rules is considered as learners produce different types of Portuguese words, discussed in the following section.

1.5 Different Word Types

The different word types which are of interest in the present study are cognates (true or false), non-cognates and nonce words. Typically, cognates and non-cognates have been discussed in the literature, with respect to L2 and L3 acquisition, in one of two ways: 1) as lexical items to be acquired by learners (e.g., Singleton, 1999; Gass & Selinker, 2001); or 2) as items in speech production studies aimed at gaining a better understanding of how the bilingual or multilingual brain handles lexical storage of and access to its different languages (e.g., Costa, Santesteban and Caño, 2005). Nonce words, or pseudo words, have typically been used in studies examining reading skills (e.g., Defior, Martos & Cary, 2002). The present study considers these word types from a rather different perspective, as it examines the effect of these word types on the acquisition of sound-symbol correspondence rules in L2 or L3. Nevertheless, a brief consideration of the literature with respect to these word types may be helpful in forming predictions about their interaction with the sound-symbol correspondence rules examined here.

Generally, vocabulary items which are cognates in different languages are seen to be relatively easy to acquire (e.g., with respect to Spanish and Portuguese, Chandler, 1958; Resnick, 1945; Garrison, 1979), as their orthographic (and often phonological) relatedness in the two languages is high. There are, of course, pitfalls with cognates, if they differ slightly in spelling and/or pronunciation in the two languages, as learners must first be aware of these differences

and, second, commit these differences to memory if the vocabulary items are to be produced correctly in speech and in writing (Resnick, 1945). Another danger for learners is when cognates turn out to be false cognates in different languages, where the orthography and/or phonology may be similar but the meaning differs (e.g., *brincar* in Spanish means “to jump” while in Portuguese it means “to play, to joke”). Again, these are words which learners must make an effort to remember in order for them to be used correctly. Nevertheless, the high degree of relatedness of cognates makes them easily recognizable to new learners, and therefore generally easier to remember and use than other new vocabulary items which bear little or no orthographic or phonological resemblance to the L1 (non-cognates).

The effect of word differences has also been considered in cognitive studies, with the objective of understanding better how bi- and multilingual learners’ organize their mental lexicon(s). An exhaustive discussion of brain organization is beyond the scope of this dissertation, but a brief mention of the effects of word relatedness in production is warranted here. For more on bilingual mental organization, refer to Singleton (1999), for example.

In speech production studies using related words in picture-naming studies, response times tend to suggest that relatedness may or may not be advantageous. In a picture-naming study with Dutch-English bilinguals, where Hermans, Bongaerts and Schreuder (1998) used phonologically related and unrelated words as distractors, response times were longer when the distractors were phonologically related to the L1 translation of the L2 target word. For instance, learners shown a picture of a mountain (*berg* in Dutch) were slower with the phonologically related distractor word *berm* (“verge”) than with the phonologically unrelated word *kaars* (“candle”). Although the related (distractor) words which Hermans et al. used were not cognates, and while they were not interested in orthography in their study, nevertheless there are aspects of their methodology

which relate to the present study. To a large extent, the related words which Hermans et al. presented were orthographically similar to the words targeted for production, and the current study presents words which are orthographically similar (cognates) and dissimilar (non-cognates and nonce words) in learners' previous languages and the target language, in order to determine whether there exists an element of "distraction" in related words which is not to be found in unrelated words. Given the results of the Hermans et al. study, where related words had a negative effect on the target words, it is possible to hypothesize that word type will have an effect on production in the present study, with related words (cognates) being produced less accurately than unrelated words (non-cognates and nonce words).

On the other hand, facilitatory effects have been found for cognates, which are related words of a different kind from those used by Hermans et al. While their words were phonologically and orthographically related, they were not also semantically related, as cognates are (except in the case of false cognates). In a review of the literature, Costa, Sanstesteban and Caño (2005) found several production studies which showed a positive effect, insofar as speed and accuracy were concerned, with naming cognates but not non-cognates (e.g., Costa, Caramazza & Sebastián-Galles, 2000; Kroll, Dijkstra, Janssen & Deslauriers, 2000), even with aphasic bilingual speakers (e.g., Roberts & Deslauriers, 1999; Kohnert, 2004). Costa et al. (2005) likened the cognate effect to neighborhood effects, where neighborhood density plays an important role in production. (Neighborhoods are made up of similar-sounding words, which share an onset, such as *cat*, *cap*, and *cash*, or which differ in only one phoneme, like *cat*, *scat*, and *at*, and dense neighborhoods are those which have many words in them. For more on neighborhoods and their effects, see Altmann, 1997.) Costa et al. (2005) stated that picture-naming studies (e.g., as Vitevitch 2002, 2003) showed that words with many neighbors were

named faster than words with few neighbors. Similarly, they claimed, the processing of cognates is facilitated, where the words have phonological overlap, as do neighbors, but across languages.

Another possibility to consider is that seen words (cognates and non-cognates in the present study) will be produced more accurately than unseen words (here, nonce words), given learner familiarity with the former. In a study looking at the acquisition of stress patterns in L2 Spanish, Lord (2007) found that L1 English speakers, with varying proficiency levels in L2 Spanish, and L1 Spanish speakers had different accuracy rates and production times when reading sentences containing real Spanish words versus sentences including synthetic (created) Spanish-like words. The results showed evidence that a learner's lexicon plays an important part in stress assignment, with known words being produced more accurately and more quickly than unknown words.

Defior et al. (2002) claimed that "it is widely accepted that the reading of [nonce words] is a good indicator of knowledge of the alphabetic code" (p. 146), thus making them ideal items to include in order to demonstrate participants' ability to generalize GPCRs from seen words to unseen words. Considering nonce words, recall that Defior et al.'s (2002) study (previously described in detail) found that children were generally slower and less accurate when reading them (nonce words) than when reading real words (numbers).

Extrapolating these observations and results to the current study is somewhat challenging, because this study does not look at the acquisition of the words as vocabulary items per se, nor are response times recorded in the present study (since accuracy in production is the primary concern here). If the target sound-symbol correspondences in cognates are produced more accurately than those in other words (non-cognates and nonce words), that would suggest a degree of facilitation for cognates. On the other hand, if the correspondences in cognates are

produced less accurately than those in other words, that would be indicative of some form of “distraction” with cognates. Alternatively, if the target correspondences in seen words (cognates and non-cognates) are produced more accurately than those in unseen words (nonce words), that would imply that learners are relying more on direct access to the lexicon to retrieve pronunciation, rather than on the grapheme-phoneme correspondence rules to assemble the pronunciation of the items.

Given these different possibilities, it is difficult to predict the effect of the different word types on the acquisition and production of the orthographic-phonological correspondences considered in the study at hand. Nevertheless, due to the fact that some of the literature on L2 and L3 acquisition has discussed the role of cognates, non-cognates and nonce words, and given the use of different word types in reading studies which considered orthographic-phonological correspondences (e.g., Defior et al., 2002), it seems pertinent to consider these word types in this study.

1.6 The Present Study

The literature reviewed in this chapter sets the stage for the current study. Recalling its three main areas of focus – error resolution, interference and generalizability – this study looks first to address the question of how well the sound-symbol correspondences in L3 Portuguese (with L1 English and L2 Spanish, or vice-versa) are acquired. What evidence does the present study find to support Major’s (2001) OPM, which predicts an increase in L3 in a learner’s IL?

In terms of the effect of learners’ previous languages on their acquisition of an L3, the literature showed conflicting results in several areas: 1) whether or not there is an advantage for bilinguals over monolinguals in the acquisition of a new language (Cenoz, 2003); 2) whether proficiency in the L2 has to be low or high in order for it to be the source of transfer for the L3 (Odlin, 1989; Poulisse & Bongaerts, 1994; Shanon, 1991; vs. Hammarberg, 2001); and 3)

whether or not facilitation occurs between typologically similar languages (e.g., Ecke and Hall, 2000; vs. Gibson, Hufeisen and Libben, 2001). Given these mixed observations, the current study questions what the nature of interference is with respect to the sound-symbol correspondences in question. To what extent are the GPCRs in the L3 “colored” (to extrapolate from Flege, 1987, and Baker & Trofimovich, 2005) by the GPCRs in the L1 and/or the L2? What evidence is there for the effect of language status (L1/L2) versus language typology (similar/dissimilar) in the acquisition of the L3 correspondence rules? It was also observed in the literature reviewed that Portuguese instructors might be aware of interference from Spanish but that this has been based more on observation than empirical evidence (Azevedo, 1978), and that further research on the acquisition of Portuguese by Spanish speakers is necessary (Carvalho, 2002). Thus, the current study also asks what the relationship is between proficiency in Spanish and acquisition of Portuguese.

As far as generalizability is concerned, the main question is to what extent learners are able to generalize the GPCRs learned, from seen words (cognates and non-cognates) to unseen words (nonce words). Thus, it is of interest to know what differences arise in production due to different word types. What support is there for Defior et al.’s (2002) and Lord’s (2007) findings, where known words (here, cognates and non-cognates) were read faster and more accurately than unknown words (nonce words)? Or is there evidence to suggest that there is a difference between production of related words – cognates – and unrelated words – non-cognates and nonce words (to extrapolate from Hermans, Bongaerts & Schreuder, 1998, and Costa, Sanstesteban and Caño, 2005)?

The next chapter describes the design of this study, as well as the methods used in data collection, transcription and analysis. Chapters three, four and five present and discuss the

findings related to each of the three research questions (error resolution, interference and generalizability, respectively). The final chapter brings the dissertation to a close, discussing implications from the study, as well as limitations and future directions.

Table 1-1. Symbols examined, Portuguese sounds, and examples

Symbol	Portuguese Sound	Example
<z>	[z]	<i>zebra</i> [zebra] (“zebra”)
Intervocalic <s>	[z]	<i>casa</i> [kaza] (“house”)

Table 1-2. Symbols examined, Portuguese contexts and sounds, and examples

Symbol	Portuguese Context	Portuguese Sound	Example
<z>	All contexts	[z]	<i>zebra</i> [zebra] (“zebra”)
<s>	Intervocalic	[z]	<i>casa</i> [kaza] (“house”)
<s>	Before <d>	[z]	<i>desde</i> [dezɔʒi] (“since”)
<s>	Before <g>	[z]	<i>vesgo</i> [vezgu] (“cross-eyed”)
<s>	Before <n>	[z]	<i>asno</i> [aznu] (“donkey”)
<s>	Before <m>	[z]	<i>mesmo</i> [mezmu] (“same”)
<s>	Word-initial	[s]	<i>sapato</i> [sapatu] (“shoe”)
<s>	After <ɫ>	[s]	<i>balsa</i> [bawsa] (“ferry”)
<s>	After <n>	[s]	<i>ganso</i> [gãsu] (“goose”)
<s>	After <r>	[s]	<i>urso</i> [usu] (“bear”)

Table 1-3. Symbols examined, Spanish sounds, and examples

Symbol	Spanish Sound	Example
<z>	[s]	<i>caza</i> [kasa] (“hunt”)
Intervocalic <s>	[s]	<i>casa</i> [kasa] (“house”)

Table 1-4. Symbols examined, English sounds, and examples

Symbol	English Sound	Example
<z>	[z]	<i>zebra</i>
Intervocalic <s>	[z]	<i>raisin</i>
Intervocalic <s>	[s]	<i>basin</i>
Intervocalic <s>	[ʒ]	<i>Asian</i>

CHAPTER 2 METHODOLOGY

2.1 Introduction

In the present study, participants enrolled in introductory Portuguese classes at the university level were recorded at three intervals during their semester of instruction (at the beginning, in the middle, and at the end of the semester), as they read a series of Portuguese or Portuguese-like words including English-Spanish-Portuguese orthographic cognates, non-cognates and nonce words containing certain grapheme-phoneme correspondences. To follow is a presentation of the research questions that motivated the study, as well as initial hypotheses concerning these questions. Thereafter is a detailed description of the methodology used in the study to test these hypotheses, including participants and materials, as well as the procedures of data collection, transcription and analysis. Concluding this chapter is an overview of subsequent chapters.

2.2 Research Questions and Hypotheses

In the literature reviewed in the previous chapter, it was claimed that the part played by the L3 in a learner's IL would increase over time, while the role of the L1 and L2 would decrease (Major 2001). In terms of the nature of interference, on the one hand, there was the claim that the lower the learner's proficiency in the L2, the greater the likelihood of language transfer from the L2 to the L3 (Odlin, 1989; Poulisse & Bongaerts, 1994); on the other hand, there was the belief that there must be a certain degree of proficiency in the L2 in order for it to be the basis of transfer to the L3 (Hammarberg, 2001). Language typology was suggested to be a significant factor in transfer (Cenoz, 2001), with the typologically similar language being the source of transfer more often than the typologically dissimilar language. As far as word effects, priming studies showed delayed response times when phonologically related distractor words were used

(Hermans, Bongaerts & Schreuder, 1998), but also positive effects for cognates (Costa, Sanstesteban and Caño, 2005), and nonce words were seen to be read with less speed and accuracy than real words (Defior et al., 2002; Lord, 2007). The current study addresses these areas of error resolution, interference and generalizability (word type) by examining the acquisition of L2 and L3 orthographic-phonological correspondences. Although these areas overlap to some extent, and certain questions apply in all three cases, they are presented and discussed separately hereafter, for the sake of clarity.

2.2.1 Error Resolution

Three basic research questions (R. Q.) arise with regard to error resolution, listed here with hypotheses (H.) concerning participant production.

R. Q. 1. To what extent do learners acquire the Portuguese grapheme-phoneme correspondence rules (GPCRs) under consideration, throughout the course of the semester?²²

H. 1. Significant increases in correct production are expected to occur throughout the semester of instruction, at least when all production data is considered together (both graphemes, all word types, all participant groups), in accordance with Major's (2001) OPM, which predicts that a learner's IL will move towards an end state of L3.

R. Q. 2. What differences in acquisition exist between participant groups²³?

H. 2. It is hypothesized that there will be differences in correct production between the language groups, with lower accuracy being found in the production of the more proficient Spanish speakers, given the persistent problems discussed in the literature with regard to Spanish speakers learning Portuguese pronunciation (Azevedo, 1978; Jordan, 1991; Tarquinio, 1977).

²² For the purpose of this dissertation, acquisition is measured by the correct pronunciation of the target Portuguese GPCRs, although in some cases correct production may actually result from positive transfer from English, as will be discussed further below.

²³ Participants and their grouping will be described further in section 2.3.1.

R. Q. 3. What differences in acquisition are there between the two graphemes <z> and intervocalic <s> corresponding to the phoneme /z/?

H. 3. It is anticipated that there will be significant differences between tests for both graphemes, and significant differences between the two graphemes, based on the fact that one of them has a one-to-one grapheme-phoneme correspondence in Portuguese (<z>-/z/), while the other does not (<s>-/z/ in intervocalic position and before voiced consonants, <s>-/s/ elsewhere), and in light of the much documented problem of devoicing of intervocalic <s> (Azevedo, 1978; Jordan, 1991; Tarquinio, 1977).

2.2.2 Interference

There are several principal questions concerning interference, presented here with hypotheses regarding participant production.

R. Q. 1. What evidence is there of interference from the L1 and/or the L2?

H. 1. It is anticipated that there will be evidence of interference from both the L1 and the L2, with these reducing over time, given the predictions made by Major's (2001) OPM that the learner's initial IL consists in part of the L1 and in part of the L2, with these decreasing over time. To extrapolate somewhat from the OPM's prediction that the universals (U) component will increase and then decrease throughout the course of the IL, it is hypothesized that there will be evidence in the data that participants are producing sounds which are neither consistent with the correspondence systems of the L1/L2 nor with that of the L3. Such production is expected to reflect universal tendencies toward unmarked features, such as voicelessness.

R. Q. 2. What differences in interference are there between participant groups?

H. 2. Given the conflicting claims in the literature with regard to the relationship between proficiency in the L2 and the level of transfer from the L2 to the L3 (e.g., Odlin, 1989; Poullisse & Bongaerts, 1994; vs. Hammarberg, 2001), it is difficult to predict what differences might exist

between participant groups in the present study. Certainly it would seem that there should be differences between participant groups of different language backgrounds and L2 proficiency levels. If the “weaker” L2 is the greater source of interference, then native English speakers should show greater interference from Spanish, while native Spanish speakers should show greater transfer from English. On the other hand, if there must be a certain level of proficiency in the L2 in order for it to be the basis of transfer to the L3, then L1 English speakers who are more proficient in Spanish should show greater transfer from L2 Spanish than L1 English speakers who are less proficient in Spanish. At the same time, proficient L2 English speakers would be expected to show greater transfer from English than from Spanish. Alternatively, it may be that all participants will transfer to a greater extent from the more similar language (Spanish) than from the less similar language (English). Given the researcher’s own observations in the classroom, the hypothesis selected here is that the higher the proficiency level in the closely related language, Spanish, the more evidence of transfer there will be from that language in the target language production.

R. Q. 3. What differences in interference exist between the two graphemes <z> and <s>?

H. 3. It is expected that there will be differences between the two graphemes, in light of the GPCRs in English, Portuguese and Spanish, and in view Muller and Muller’s (1968) prediction about the most difficult GPCR to acquire being of the AX AY type (where language 1 has sound X for a particular grapheme A and language 2 has sound Y for that same grapheme A). Since grapheme <z> always has the same correspondence rule in English and Portuguese (although not in Spanish), but grapheme <s> only sometimes has the same correspondence rule in English and Portuguese (and never in Spanish), it is anticipated that there will be greater accuracy in production of <z> due to the possibility of positive transfer from English, and less accuracy in

production of <s> due to the possibility of only negative transfer from Spanish and generally negative transfer from English.

R. Q. 4. To what extent is production in Spanish related to acquisition (correct production) of Portuguese?

H. 4. It is anticipated, based on the researcher's own classroom observations and impressions, as well as observations in the literature about the difficulty encountered by Spanish speakers with Portuguese pronunciation, in particular with intervocalic <s> (e.g., Azevedo, 1978; Tarquinio, 1977; Jordan, 1991), that production in Spanish will be inversely related to acquisition of the Portuguese GPCRs in question. That is, it is expected that the greater the accuracy in Spanish production, the lower the accuracy in Portuguese production will be.

2.2.3 Generalizability

The term generalizability is used here to refer to participants' ability to apply the GPCRs learned for seen words (cognates and non-cognates) to unseen words (nonce words). There is one principal question to be answered here, along with a hypothesis regarding participant production.

R. Q. 1. What differences in production arise due to word type (cognates, non-cognates and nonce-words)?

H. 1. On the one hand, given findings that real words were read faster and more accurately than nonce words (Defior et al., 2002; Lord, 2007), it would be expected that the L2 and L3 participants in the current study would perform better on real words than on nonce words. On the other hand, extrapolating Hermans et al.'s (1998) and Costa et al.'s (2005) findings that related words (cognates) affected production to a greater extent than unrelated words (non-cognates and nonce words), where the former found related words to have a negative effect, and the latter found them to have a positive effect, it might be expected in the present study that cognates would affect production to a greater or lesser extent than non-cognates and nonce words. Given

the literature, it is difficult to predict what the current study will show with regard to the relationship between word type and the acquisition of the GPCRs in question, so once again, the researcher's classroom observations are instrumental in hypothesis selection here. It is predicted that the orthographic-phonological correspondences in seen words (cognates and non-cognates) will be produced more accurately than those in unseen words (nonce words), due to learners' greater familiarity with and exposure to the former. That is, production will be lexically driven rather than rule driven.

In answering these research questions, a better understanding of L3 production will be gained. A contribution to the general body of research will be made by finding evidence to support – or not support – the theoretical framework and previous studies cited, with insight added regarding the role of an L3 learner's previous languages in the acquisition process. Pinpointing the source of interference in an L3 learner's IL is not straightforward (Dewaele, 1998), and by considering the acquisition of specific orthographic-phonological correspondences, stronger conclusions may be drawn than have been possible thus far with regard to the source(s) of interference. With these thoughts in mind, the next section presents the methodology used in the current study, in order to test the hypotheses and answer the research questions.

2.3 Methodology

Consideration will be given first to the participants involved in the present study, then to the materials and tasks developed, and finally to the methods of collecting, transcribing and analyzing the data.

2.3.1 Participants

The participants in the current study were students in three introductory classes of Portuguese: two Beginner 1 classes (the first semester of a two-semester course) and one

Introduction to Portuguese and Brazil class for fluent (native or advanced) speakers of other Romance languages (an accelerated one-semester course). All students of the three classes were asked to participate in the study just as they would participate in any class activity, since the tasks were administered during normal class time, and there was no penalty for students who failed to participate in one or more of the tasks due to absence from class on that day. Thus, participation was considered voluntary, since no additional time commitment outside of class was required and there was no penalty for non-participation. Before participating, the students indicated that they had been informed about the study and its requirements by completing a consent form (Appendix A).

Next, participants completed a questionnaire (Appendix B), giving details about the languages they spoke, whether they were native speakers of them, how and when they had learned these languages, and with whom and where they used them. They were also given descriptions of four proficiency levels (1 being the lowest and 4 being the highest) for the four skills of listening, speaking, reading, and writing, and were asked to rate themselves for each language by choosing from the descriptions the proficiency level that they felt most closely reflected their own. (Participants were not asked to rate themselves for English, since it was presumed that all were proficient, if not native, English speakers, due to their enrollment in an English-speaking institution of higher education.)

Of the 66 students who participated in the study, data from 52 were chosen for inclusion in the analysis. This selection was based upon two criteria: 1) attendance all three times the task was administered; and 2) audible (and therefore usable) recordings. No participants were eliminated based on questionnaire answers. (The questionnaire asked participants if they had ever been diagnosed with a reading disorder, such as dyslexia. Had anyone responded

affirmatively to this question, which was not the case, their data would most likely have been excluded.)

For the purpose of data analysis, participants were divided into groups, based on the information they supplied in the questionnaire (summarized in Appendix C), and on the course (beginner or accelerated) in which they were enrolled. It bears mentioning here that, at the institution where the data were collected, enrollment in Portuguese is relatively low (at least compared with Spanish and French, for instance), and there is no standardized placement test for students. Those who enroll in the accelerated introductory class, designed for speakers of other Romance languages, have generally taken classes or a placement test in the other language, are native speakers of that language, or occasionally, are heritage speakers of Portuguese. Sometimes, informal interviews with the instructor or coordinator are conducted for the purpose of assessing the student's level of proficiency in their other Romance language(s) in order to ensure that they enroll in the appropriate Portuguese class. Those who do not meet the criteria for the accelerated class enroll in the beginner class. It is worth mentioning that, occasionally, when scheduling conflicts occur, these enrollment criteria are not strictly adhered to, due to the limited number of classes offered each semester and the desire to have enrollment be as high as possible. When this happens, students who would otherwise be in the accelerated class are sometimes permitted to enroll in the beginner class, but never vice-versa, due to the difficulty that beginner students would encounter in the accelerated class.

The 52 participants in the present study were initially divided into five groups (Table 2-1). After initial data analysis, where no significant differences were found between group O and any of the other groups apart from S, the five groups were collapsed into four (Table 2-2). The results which led to this finalized grouping are discussed in Chapter 3.

2.3.2 Materials

In order to examine participants' production at different points during the semester of instruction, with respect to the orthographic-phonological correspondences considered in the study²⁴, a reading task was developed, which required participants to read 130 words in Portuguese, 36 words in English and 20 words in Spanish (Appendix D). The English and Spanish words were given only the first time the task was administered, to ascertain participants' knowledge of the GPCRs of those languages for the graphemes considered in the current study. The task was created specifically to require reading of the graphemes in all three languages and to elicit the production of target sounds in all three languages, as much as possible²⁵. Spontaneous oral data would not have been appropriate for this study because participants would not have been able to produce anything at the beginning of the semester, given that most of them had no previous exposure to or instruction in Portuguese. Even if this were not the case, it would be difficult to ensure production of sufficient instances of the target grapheme-phoneme correspondences by all participants in natural speech. Additionally, early learners such as these might feel more anxious about being recorded while producing spontaneous oral data than during a reading task such as the one developed.

The English and Spanish words were all real words, all of which contained either target graphemes or graphemes which would elicit the target sounds examined in the study, but whether or not they were cognates or non-cognates with each other or with Portuguese was not taken into account, since their purpose was simply to demonstrate participants' knowledge of the

²⁴ The study was designed to consider six sound-symbol correspondences: <z>-[z], intervocalic <s>-[z], <j>-[ʒ], <ge/gi>-[ʒ], initial <r>-[h], intervocalic <rr>-[h]. However, due to the complexity of the project, only data for the first two of these correspondences are analyzed and discussed in this dissertation. Nevertheless, this chapter makes mention of the six correspondences since they formed part of the materials developed and used.

²⁵ Recall that the phoneme /z/ does not occur in Spanish, although it is possible for <s> to be pronounced as [z] before the voiced consonants <m>, <n>, and <d>, as in *mismo* ("same"), *asno* ("donkey") and *desde* ("since").

GPCRs in English and Spanish, and their physical ability to produce the sounds. The Portuguese words consisted of:

- 48 English-Spanish-Portuguese cognates (C), such as *básico* (“basic”) and *horizonte* (“horizon”)
- 35 non-cognates (NC), such as *casaco* (“coat”) and *zangado* (“angry”)
- 37 nonce words (N), such as *feserel* and *paimozes*
- 10 filler words (F) which did not contain any of the target graphemes, such as *chato* (“boring”) and *criança* (“child”)

As far as possible, the cognates and non-cognates were taken from the textbook, *Ponto de Encontro* (Klobucka, A., Jouët-Pastré, C. M. C., Moreira, M. L. de B., Sobral, P. I., & Hutchinson, A. P., 2007) that participants used for class. While classroom materials and instruction were not factors examined in this study, a brief note on them is warranted here. Although the textbook itself makes no reference to pronunciation, pronunciation guides and exercises appear throughout ancillary reference materials such as the accompanying *Student Activities Manual* and online audio exercises. Students are expected to read these notes regarding pronunciation on their own, outside of the classroom, but pronunciation is also taught and reinforced in the classroom. At the beginning of the semester, one or two class periods in both class levels are dedicated to explicit instruction regarding orthographic-phonological correspondence rules, and correction is offered to a certain extent (not measured) throughout the semester of instruction.

Because participants were enrolled in different courses that progressed through the textbook at different rates, only words from the first three chapters were used (i.e., the chapters covered by all classes between the first and second administrations of the task), in an effort to ensure that all participants would have been exposed to the cognate and non-cognate words by the time the task was administered for the second time. In some grapheme-phoneme-word type

categories, it was not possible to find sufficient tokens from the vocabulary found in the textbook, so to make the categories as balanced as possible, words were added, such as *manhoso* (“smart,” “whiny”) which was added to the <s>-[z]-NC category, and *azedo* (“sour”) which was added to the <z>-[z]-NC category. Nonce words were created by listing all of the syllables found in the cognate and non-cognate words, then using the random function in Excel to rearrange them to yield words with two, three or four syllables. Any syllables or words which were phonotactically impossible or unlikely to occur in Portuguese were excluded. For example, words ending in <n> are very rare in Portuguese so any nonce word created with a final <n> was excluded. The pronunciation of the target graphemes in the nonce words was agreed on by the three raters in the study (Section 2.3.4 provides more information about the raters). Of the 120 non-filler words, 13 contained two target correspondences, such as *realizado* (“realized”) which contained the initial <r>-[h] and <z>-[z] correspondences, yielding a total of 133 target correspondences for consideration. Of these, 53 were found in cognates, 40 in non-cognates and 40 in nonce words. Of the 133 tokens, 42 contained the target phoneme /h/ (24 <r> and 18 <rr>), 49 contained the target phoneme /z/ (30 <s> and 19 <z>), and 42 contained the target phoneme /ʒ/ (22 <g> and 20 <j>).²⁶

Considering only the <z> and <s> words which are analyzed and discussed in this dissertation, the 49 words were later reduced to 48, as it was noticed that the <s> in one of the words in the <s>-[z]-C category, *transição* (“transition”), was not intervocalic. The <s> words are shown broken down into cognates, non-cognates and nonce words (Table 2-3), as are the <z> words (Table 2-4), with asterisks marking those words which were not found among the vocabulary items listed in the textbook. It is worth mentioning here that three sets of cognate <s>

²⁶ Recall that only the /z/ items are analyzed here; the analysis of the other sounds is beyond the scope of this dissertation.

words were included, due to the three possible pronunciations of <s> in English: [z] as in *raisin*; [s] as in *basin*, and [ʒ] as in *Asian*. The C1 cognates are those where English would have [z], the C2 cognates are those where English would have [s], and the C3 cognates are those where English would have [ʒ].

A PowerPoint (2003) presentation was created with instructions for the participants, followed by the words to be read in each language, with each word appearing on a separate slide. After initial instructions, all the Portuguese words were shown, followed by a slide indicating the end of the Portuguese words and the beginning of the English words. After the English words came another slide indicating the end of the English words and the beginning of the Spanish words. After the Spanish words, there was a slide which indicated the conclusion of the task (Appendix E shows the instruction slides and examples of the words that participants saw for each language). For all three languages, the words were randomly ordered, using the random function in Excel, then two versions of the PowerPoint presentation were created, “Odd” and “Even,” since participants were seated in odd and even numbered recording booths in the Language Learning Center. “Odd” had Portuguese words 1-130, English words 1-36 and Spanish words 1-20; “Even” had Portuguese words 66-130 followed by 1-65, English words 19-36 followed by 1-18, and Spanish words 11-20 followed by 1-10. The purpose of the two versions was to roughly control for fatigue and to minimize distractions from neighboring participants, since all participants were reading and being recorded at the same time.

2.3.3 Data Collection

Data were collected at the university’s Language Learning Center, where participants sat at booths equipped with a computer, monitor and headphones with attached microphone. Seated at booths numbered with odd and even numbers, participants were instructed to open the

PowerPoint version (“Odd” or “Even”) respective to their booth number²⁷. After reading the instructions in the PowerPoint file, participants were instructed to begin speaking, at which point recording was started by the researcher, from a central computer, using a Sanako Lab 300 system. Participants were able to go at their own pace, clicking the mouse or pressing a key on the keyboard to move from one slide to the next. It was felt that, by allowing participants to proceed when ready, they would not become bored by having to wait for the slides to advance automatically, nor would they be pressured if the slides were moving too quickly for them. The main disadvantage of having participants advance through the slides on their own was that they could skip slides, inadvertently or on purpose. Still, it was felt that this disadvantage was outweighed by the advantages, so it was deemed better to have participants progress at their own rate. Once all participants had finished reading, the recording was stopped, again by the researcher, and the recorded data was captured into individual files for each participant and saved on an external drive.

The reading task was administered three times throughout the semester: 1) on the second day of class, before any formal instruction on pronunciation had been given; 2) during Week 8 of a 16-week semester; and 3) during Week 15 of the 16-week semester. Participants read the 130 Portuguese words each time the task was administered, while the English and Spanish words were read only on the first occasion. Whether or not participants read the same version (“Odd” or “Even”) on each occasion was not deemed important – since participants themselves would likely not remember the order in which the words had been presented in previous tests – and thus was not verified.

²⁷ Whether or not participants opened and used the correct version was not verified precisely. Observing that alternating participants seemed to be reading different versions was deemed sufficient verification.

Once all the data had been collected, the files were examined for acoustic problems during the recording process, as well as any gaps in individual participation (that is, where a participant failed to attend one or more test dates). Then, using Adobe Audition, each file was truncated at the beginning to remove the participant's name and at the end to remove the empty portion after the participant had finished the reading task, in preparation for raters to listen to the recordings. Once the recordings had been prepared for the raters, the files were identified by random numbers to ensure anonymity.

2.3.4 Transcription

Three raters listened to all of the data. Rater 1 is a native speaker of Brazilian Portuguese (from Rio de Janeiro) but not a linguist. Rater 2 is a highly fluent speaker of Brazilian Portuguese and a linguist. Rater 3 (the researcher) is a native speaker of Brazilian Portuguese (from São Paulo) and a linguist. All three raters were instructors of Portuguese at the university at the time of data collection: rater 1 was the instructor of the two beginner classes; rater 2 was the instructor of the accelerated class for speakers of other Romance languages; and rater 3 was the instructor of other classes which did not participate in the study. While perhaps somewhat undesirable, the use of the instructors and the researcher as the raters in the study was necessary due to a lack of other fluent Portuguese speakers available.

Before carrying out the ratings, the researcher met with the other two raters for training on how to transcribe and assess the recorded data. Recordings from a pilot study were used in the training, so that the raters would be familiar with the words and target sounds to be transcribed without actually being exposed to (and perhaps prejudiced by) any of the data from the present study. The researcher reviewed the target Portuguese sounds for the six graphemes under consideration in the study, as well as some of the alternate sounds which participants were hypothesized to produce, based on their knowledge of English and Spanish pronunciation rules.

Raters 2 and 3, the linguists, were familiar with the IPA symbols necessary to transcribe all possible sounds, but a guide (Appendix F) was produced especially for rater 1, the non-linguist. The guide showed words in Portuguese, English and Spanish, with highlighted graphemes and the symbols for their respective sounds, to facilitate transcription. Alternative sounds (due to dialectal variation) were indicated with slash marks on the guide. Raters 1 and 2 were also instructed to consult with the researcher (rater 3) if they were unsure how to transcribe a particular sound²⁸.

Provided with necessary equipment, all three raters listened to all of the data on their own, and transcribed the target sounds for each word, as had been discussed in the training session. Including those in the filler words, the number of target graphemes transcribed per participant, per task, was 155. To facilitate the process, transcription sheets (Appendix G) were provided for the raters to circle the sounds heard, with four columns for each target grapheme/phoneme: the first column contained the symbol for the sound expected for someone using English pronunciation rules; the second column contained the symbol expected for someone using Spanish pronunciation rules; the third column contained the symbol for the (correct) target Portuguese sound; and the fourth column was left blank for the rater to write in the symbol for a sound other than those in the first three columns. Raters either circled one of the symbols listed on the sheet or wrote in a symbol if it was not listed.

All of the raters' transcriptions were entered into an Excel spreadsheet then compared in order to calculate inter-rater agreement. In cases where one rater did not agree with the other two, the majority rating was selected (Lord, 2007). As relates to <s> and <z> items only, in a very small percentage of cases (0.52%), none of the raters agreed, so the three met to listen to

²⁸ For example, rater 1 inquired about how to transcribe the voiced velar stop [g], which was not provided on the transcription guide but was used by many participants for <g> in words such as *ferrugem* ("rust").

and discuss those sounds until agreement was reached, at least between two of the raters. Table 2-5 provides details on the inter-rater agreement process for <s> and <z> items. Overall, the three raters agreed 85.03% of the time; the cases where only two raters agreed were fairly evenly distributed: Raters 1 and 2 (but not rater 3) agreed 3.58% of the time; raters 1 and 3 (but not 2) agreed in 4.49% of instances; and raters 2 and 3 (but not 1) agreed on 6.9% of the items.

2.3.5 Analysis

For the purpose of statistical analysis, the data entered into Excel were assigned different numerical and alphabetic values for different purposes. (Appendix H shows a sample of participant production for <z> and <s> tokens, as well as the numerical and alphabetic values assigned to each sound.) In order to examine participants' accuracy with respect to Portuguese pronunciation, numerical values were assigned: a score of 1 for a correct (target) Portuguese sound, and 0 for anything else. Scores were then summed per participant, per grapheme, and per word type for each test, to facilitate analysis.

Separately, the data were examined for the sounds which participants produced (such as the projected English or Spanish sound on the rating sheet, or the target Portuguese sound). The sounds were assigned alphabetic values as follows: 1) EN for transfer from English (based on English pronunciation rules), when transfer from Spanish or correct pronunciation in Portuguese would differ from English, such as the realization of the <s> in *visual* ("visual") as [ʒ]; 2) EP for instances when English and Portuguese pronunciation rules coincided but differed from Spanish, such as the realization of the <s> in *presidente* ("president") or the <z> in *horizonte* ("horizon") as [z]; 3) ES for cases when English and Spanish pronunciation rules coincided with each other but differed from Portuguese, such as the realization of the <s> in *básico* ("basic") as [s]; 4) NO when participants produced nothing for a target phoneme (either because syllables were skipped or transposed, or because entire words/slides were skipped); 5) OTH when a sound was produced

other than the sounds expected by the rules of English, Portuguese and Spanish, such as the realization of the <s> in *visual* (“visual”) as [ʃ]; 6) PO when production was correct according to the Portuguese rule, where this differed from the English and Spanish rules, such as the realization of the <s> in *básico* (“basic”) as [z]; and 7) SP for transfer from Spanish (based on Spanish pronunciation rules) when the Spanish rule differed from the English and Portuguese rules, such as the realization of the <s> in *presidente* (“president”) or the <z> in *horizonte* (“horizon”) as [s]. Each of these alphabetic values was then summed per participant, per grapheme and per word type for each test, to facilitate analysis. Once participant scores were summed, they were calculated as percentages of the total number of items per category, due to the unbalanced nature of the categories (e.g., there were 17 cognate <s> items but only six cognate <z> items per test). These percentages were then imported into SAS for statistical analyses to be carried out. The statistical tests conducted are described separately here, according to the research question they were intended to address.

With regard to the first research question, concerning error resolution, a general linear model (mixed effects) was used to analyze the percentages calculated from the numerical scores assigned to each sound produced, considering as factors the 52 participants (random factor), and as fixed factors: the five participant groups²⁹, three tests, two graphemes and three word types, to yield a total of 936 observations.³⁰ Tukey post-hoc t-tests were conducted when necessary, to establish where there were significant differences, and all analyses used a significance level of $\alpha=0.0005$. The output from the model and the results of the t-tests are presented and discussed in Chapter 3.

²⁹ These five groups were later reduced to 4, as discussed in greater detail in the next chapter.

³⁰ Note that the same model was used to address the third research question, regarding generalizability, which is discussed separately momentarily.

For the purpose of addressing the second research question, regarding the role of interference in acquisition, a general linear model (mixed effects) was used to analyze the percentages calculated from the alphabetic scores assigned to each sound produced, considering as factors the 52 participants (in four groups), three tests, and seven production types for <s>, to yield a total of 1092 observations. For <z>, the factors considered were the 52 participants (in four groups), three tests, and four production types, to yield a total of 624 observations. Tukey post-hoc t-tests were conducted when necessary, to establish where there were significant differences, and all analyses used a significance level of $\alpha=0.0005$. All production was considered by group and grapheme, according to the various production types. The output from the model and the results of the t-tests are presented and discussed in Chapter 4. In order to address the question on the relationship between accuracy in Spanish production and accuracy in Portuguese production, a regression model was used to analyze participants' production on the Spanish reading task compared with average production for the three Portuguese reading tasks. The results of the regression model are also presented and discussed in Chapter 4.

As for the third research question, regarding generalizability, the results of the general linear model used to address the first research question were also used to address the third question, where the results relevant to the latter question pertain to the fixed factor word type. Tukey post-hoc t-tests were conducted when necessary, to establish where there were significant differences, and all analyses used a significance level of $\alpha=0.0005$. All production was considered together, then production by grapheme was examined. Next, the cognate <s> words were divided into three sets, according to the sound in the English equivalent ([s], [ʒ]) or [with production of these sets being considered according to participant group. The output from the model and the results of the t-tests are presented and discussed in Chapter 5.

In the final chapter, the results of the present study are reviewed, with respect to the research questions it set out to answer and the hypotheses proposed, and the study's contributions and implications are discussed, as well as its limitations and future directions.

Table 2-1. Participant groups

Group	Group Description	No.
E1	Native English speakers with no/low proficiency in Spanish (beginner class)	21
E2	Native English speakers with high proficiency in Spanish (accelerated class)	4
P	Participants with previous exposure to or instruction in Portuguese	9
O	Participants with exposure to or instruction in other foreign languages	9
S	Native Spanish speakers	9

Table 2-2. Revised participant groups

Group	Group Description	No.
E1	Native English speakers with no/low proficiency in Spanish (beginner class)	25
E2	Native English speakers with high proficiency in Spanish (accelerated class)	5
P	Participants with previous exposure to or instruction in Portuguese	9
S	Native Spanish speakers	11

Table 2-3. Grapheme <s> words

C1 <s>	C2 <s>	C3 <s>	NC <s>	N <s>
apresentação	básico	audiovisual	atencioso	disudo
esquisito	casos	decisão	casaco	fesere1
museu	curiosidade	divisões	desenho	iságio
presidente	filosofia	revisão	manhoso*	lomosa
visível	generosidade	televisão	poloneses	maresa
	persuasivo	visão	preguiçoso	quasano

* Indicates words not in textbook.

Table 2-4. Grapheme <z> words

C <z>	NC <z>	N <z>
colonização	azedo*	bazerão
horizonte	búzios	paimozes
idealização	dúzia*	pastiza
localizado	gizes (pl*)	prozida
organização	lazer	trazentar
realizado	rapazes	zalito
	zangado	

* Indicates words not in textbook.

Table 2-5. Summary of inter-rater agreement for <s> and <z> items (number and percentage)

Test	Raters 1 & 2	Raters 1 & 3	Raters 2 & 3	Raters 1, 2 & 3
1 items agreed on (#)	107	126	205	2058
1 items agreed on (%)	4.29	5.05	8.21	82.45
2 items agreed on (#)	82	102	165	2147
2 items agreed on (%)	3.29	4.09	6.61	86.02
3 items agreed on (#)	79	108	147	2162
3 items agreed on (%)	3.17	4.33	5.89	86.62
All items agreed on (#)	268	336	517	6367
All items agreed on (%)	3.58	4.49	6.90	85.03

CHAPTER 3 ERROR RESOLUTION – RESULTS AND DISCUSSION

3.1 Introduction

This chapter addresses the first broad research question, regarding error resolution, by presenting and discussing the pertinent results. Before considering these, however, it is helpful to recall the research questions asked and hypotheses stated (in section 2.2.1) concerning error resolution. The first question asked to what extent learners acquire the Portuguese GPCRs under consideration, throughout the course of the semester. It was hypothesized that correct production would increase, at least when all production data were considered together (i.e., the two graphemes, all word types, all participant groups), in accordance with Major's (2001) OPM, which predicts that a learner's IL will move towards an end state of L3. The second question explored the differences in acquisition which might exist between participant groups. It was predicted that there would be differences in correct production between the language groups, with lower accuracy being found in the production of the more proficient Spanish speakers, given the problems discussed in the literature with regard to Spanish speakers learning Portuguese pronunciation (Azevedo, 1978; Jordan, 1991; Tarquinio, 1977). The third question considered the differences in acquisition between the two graphemes <z> and intervocalic <s> corresponding to the phoneme /z/. It was expected that there would be significant differences between tests for both graphemes, and significant differences between the two graphemes would be evident, based on the one-to-one grapheme-phoneme correspondence which exists in Portuguese for <z> but not for <s> (<s>-/z/ in intervocalic position and before voiced consonants, <s>-/s/ elsewhere), and given the much documented problem of devoicing of the intervocalic <s> by L2/L3 learners (Azevedo, 1978; Jordan, 1991; Tarquinio, 1977). The results will be presented and discussed as follows: 1) all production; 2) production according to

participant group; and 3) production according to grapheme.³¹ Variation between groups and individuals will then be discussed, with a general summary of results to follow.

3.2 Results and Discussion

Results are presented here in terms of raw production scores, proportions of correct items out of all possible items per category (e.g., cognate <s>, cognate <z>, etc.), and statistically significant differences (output from the model), which are marked with an asterisk in the tables.

3.2.1 All Production

Considering together the production of all the participants, irrespective of their group, the grapheme or the word type, the data showed that correct production of [z] occurred for 845 items on Test 1, 1118 items on Test 2, and 1244 items on Test 3. Expressed as percentages of possible correct items, these scores translate to 33.85% on Test 1, 44.79% on Test 2, and 49.84% on Test 3 (Table 3-1), shown graphically in Figure 3-1. Tukey post-hoc t-tests revealed significant differences between Tests 1 and 2, Tests 1 and 3, and Tests 2 and 3 ($p < .0001$, for all three pairs of tests). These results are encouraging: they indicate that progress in accurate sound production, that is, acquisition, occurred throughout the semester. Next, production by participant group is examined, which takes participants' linguistic backgrounds into consideration.

3.2.2 Production by Group

As previously discussed in section 2.3.1, participants were grouped according to their linguistic background, based on the information that they provided on their language background questionnaires with regard to their proficiency in English, Spanish, Portuguese and other languages, and also based on the Portuguese course in which they were enrolled (beginner or accelerated). With these criteria in mind, five groups emerged (Table 3-2), as was discussed

³¹ Production according to word type (cognate, non-cognate and nonce) will be discussed in Chapter 5, which addresses the third broad research question, regarding generalizability.

previously. Due to the unbalanced number of participants in the five groups, least square means (LS means) were used instead of arithmetic means in the statistical procedures, since LS means are appropriate for unbalanced designs with more than one effect. (For more on LS means, including examples, see Khuri, 2009.) The number of correct items, and their expression as percentages of possible correct items, are shown in Table 3-3.

The ANOVA results (Table 3-4) indicated that all of the factors – group, test, grapheme, and word type – were significant, as were the interactions between group and test, group and grapheme, test and grapheme, and grapheme and word type³². Tukey post-hoc t-tests revealed significant differences between groups E1 and S ($p < .0001$), groups E2 and S ($p = 0.0384$), groups O and S ($p < .0001$), and groups P and S ($p < .0001$). Because no significant differences were found between group O and any group other than S at this point, it was decided to consolidate the participants in group O into other groups.³³ Of the nine participants originally grouped in O, six were transferred to E1, one to E2, and two to S, yielding four groups (Table 3-5).³⁴

Considering these four revised groups, the number of correct items and their expression as percentages of possible correct items were calculated (Table 3-6). Graphically, these results are shown by group (Figure 3-2) and by test (Figure 3-3). The ANOVA results using the revised groups (Table 3-7) indicated that all of the factors – group, test, grapheme, and word type – were significant, as were the interactions between group and test, and group and grapheme.

³² The interaction between grapheme and word type will be discussed in Chapter 5, which considers the effect of word type on acquisition.

³³ It seems likely that the reason for the significant difference found between groups O and S is due to the linguistic background of the participants in group O. Disregarding their proficiency in another language (besides English, Spanish and Portuguese), seven of the nine participants would be classified as E1 or E2 participants, both of which groups showed significant differences from group S.

³⁴ The interaction between language group and test found no significant differences between O and groups other than S, but there were some significant differences between other groups (E1 and E2, and E2 and P on Test 1), therefore further consolidation of these groups would not have seemed a reasonable step.

Given that the ANOVA results indicated a significant interaction between group and test, Tukey post-hoc t-tests were carried out to establish where significant differences existed. These were found between tests for all groups, though not between all tests (Table 3.8). Once again, it is encouraging to find that each group makes significant progress throughout the semester of instruction in terms of accurate production, at least between the first and third tests.

Significant differences were also found between groups E1 and E2 on Test 1, between groups E1 and S on all three tests, between groups E2 and P on Test 1, and between groups P and S on all three tests (Table 3.9 – tests are indicated in parentheses). These results are worth highlighting, for they show that native English speakers with high proficiency in Spanish behaved more similarly to native Spanish speakers than to other native English speakers (with no or low proficiency in Spanish), at least initially. On the second and third tests, however, there were no appreciable differences between E2 and any of the other groups. While this was not unexpected for Test 2, it was a little unexpected for Test 3, at which point there were no significant differences between E1, E2 and P, but there were significant differences between E1 and S, and between P and S. The reason for this may lie in the fact that group E2 had a low number of participants, relative to the other groups, which led to a less conclusive statistical result (the standard errors in the differences of LS means on Test 3 were: 5.5453 for E1 and S, 6.9680 for P and S, and 8.3616 for E2 and S), so that a statistical difference between E2 and S was not observed on Test 3. Such a difference might have been found had there been a greater number of participants in E2, a point to be remembered for future research.

3.2.3 Production by Grapheme

Now consideration will be given to the two graphemes, <s> and <z>. The ANOVA results (Table 3-7 in section 3.2.2) showed a significant difference between <s> and <z>, but did not show a significant interaction between test and grapheme ($p=0.0547$), nor was the three-way

interaction between test, group and grapheme found to be significant ($p=0.1853$), although the interaction between group and grapheme was shown to be significant ($p<.0001$). The number of correct items and their expression as percentages of possible correct items were calculated per grapheme for each group (Table 3-10). Graphically, these results are shown per group (Figure 3-4) and per grapheme (Figure 3-5).

Tukey post-hoc t-tests showed significant differences between <s> and <z> for all groups ($p<.0001$). These results clearly show the major role which the grapheme plays in pronunciation, and they would suggest that the <z>-[z] correspondence rule in Portuguese is easier for learners to acquire than the <s>-[z] rule. Between groups, significant differences were found only between groups E1 and S on <z> ($p<.0001$), between P and S on <z> ($p<.0001$), and between P and S on <s> ($p=0.0284$).

It is interesting to see that few differences emerged between groups. It was not entirely unexpected that the group of native English speakers with low or no proficiency in Spanish should perform significantly better on <z> than the group of native Spanish speakers, given that the former group has the same correspondence rule in their L1 (<z>-[z]) as in Portuguese, while the latter group has no phoneme /z/ in their L1. Nor was it particularly unexpected that the native English speakers with high proficiency in Spanish should perform similarly to the native Spanish speakers, since both groups are fluent in Spanish, a language which is so closely related to Portuguese. It is noteworthy, though, that those participants with previous exposure to Portuguese should achieve results which are significantly different only from the group of native Spanish speakers. This would suggest that the previous instruction in or exposure to Portuguese generally did not have a great impact on the learners, at least insofar as the GPCRs in question are concerned, and at least at these early levels.

3.3 Other Observations

This section highlights observations of interest with regard to production by particular individuals or groups. Correct production for each participant was summed for each grapheme on each test, and calculated as percentages of possible correct items; averages were calculated for each group (Appendix I). In this section, individual participants are referred to by group and number, for ease of reference. For instance, participant 1, in the group of participants with previous exposure to Portuguese, is referred to as P-1.

3.3.1 Production by Test and Group

First, it is noteworthy that none of the 52 participants produced all of the 48 tokens correctly, on any of the three tests, indicating room for improvement for all of the participants at the end of the semester of data collection. While this result is not unexpected for beginners of Portuguese (enrolled in either of the two Portuguese courses), it is interesting that this is the case even for the participants who had had exposure to or instruction in Portuguese prior to the semester in which the data were collected.

3.3.2.1 Production by native Spanish speakers

Contrary to expectations, the participant with the highest score on Test 1, with 71% accuracy, was a native Spanish speaker (S-39). His score went down slightly on Test 2 (63%), and remained the same on Test 3 (63%). Similarly, the participant with the highest score by the end of the semester was a native Spanish speaker (S-37), although this time performance improved from 6% accuracy on Test 1 to 35% on Test 2, and 83% on Test 3. Of the group of native Spanish speakers, S-19 achieved moderate accuracy on all three tests: 42%, 65% and 54%, and S-50 showed a dramatic improvement between the first two tests only: 0%, 40% and 46%. Production by these four native Spanish speakers was certainly not the norm for the group of native Spanish speakers as a whole. As expected, most of the other participants in group S had

much less success in accuracy: S-2 achieved 4%, 13% and 35% on Tests 1, 2 and 3, respectively; S-3 had 0%, 4% and 17%; S-4 achieved 8%, 10% and 6%; S-16 obtained 2%, 2% and 4%; S-43 achieved 0%, 4% and 19%; S-45 had 15%, 19% and 23%; and S-48 achieved 15%, 25% and 10%. The only native Spanish speaker to have had previous instruction in or exposure to Portuguese (P-1) accurately produced 8%, 25% and 44% of items, at each of the three tests.

It is worth pointing out that the two participants who had the highest scores on the first and third tests (S-39 and S-37, respectively) were the only ones who had had previous instruction in another language other than Portuguese (French, in both cases). The exposure that these participants had to French may have been a contributing factor to their increased success in the tests, in comparison with the other participants in group S. It is somewhat surprising that they performed better than the native Spanish speaking participant who had had previous instruction in Portuguese, as it would seem more plausible to assume that previous instruction in the target language (Portuguese) would be more advantageous for the acquisition of Portuguese GPCRs than previous instruction in another language (French). Of course, individual factors may come into play here, including length of exposure to and proficiency in the language in question, as well as attention to phonological details. These are factors that will have to be left for future studies.

It is also important to mention here that the group of native Spanish speakers varied with respect to their exposure to and instruction in Spanish and English. Some had spent a significant portion of their lives in Spanish-speaking countries (Colombia, Venezuela, El Salvador, Bolivia), while others had lived largely in the U.S. These differences in upbringing and instruction, not to mention other individual differences, no doubt also impacted their proficiency in English, with some learning English as an L2 and others as an L1 (along with Spanish). The English reading

task, which was administered at the time of the first test, was given to assess participants' knowledge of the English GPCRs and their ability to produce the target graphemes/phonemes. Table 3-11 gives the results of the English task, with respect to the sound [z], for the native Spanish speakers, along with a brief description of their background in Spanish. (Results for the other groups, which consisted of native English speakers, are not shown or discussed, because their production was as expected for native speakers.) There were eight English words in the task which are pronounced with [z], containing either the grapheme <s> (*gymnasium, physics, present, result*) or the grapheme <z> (*bizarre, realization, zebra, zipper*); the results in the table show how many of these words each participant produced accurately out of the eight. Also shown in the table is the highest level of accuracy that the participants achieved in the Portuguese reading tasks, as mentioned previously in this section.

The purpose of considering together the highest level of accuracy in Portuguese production and the score on the English reading task is to illustrate that accuracy in English did not necessarily correspond to accuracy in Portuguese. Participants who managed to produce all of the English [z] items correctly (19, 29, 45 and 48) achieved very different levels of accuracy in Portuguese (65%, 71%, 23%, and 25%, respectively). Also, those who did not produce any of the English [z] items accurately (2, 4, 16) achieved different levels of accuracy in Portuguese (35%, 10%, and 4%, respectively). Thus, despite obvious differences within this group, it would be difficult to come up with clear-cut criteria for dividing the group further. Hence, the group's production is still considered as a whole, in future discussions, but with the knowledge that its participants are heterogeneous in many respects.

3.3.2.2 Production by native English speakers with no or low proficiency in Spanish

As for the native English speakers with no or low proficiency in Spanish (group E1), a great deal of diversity was observed in terms of accurate production. On Test 1, for instance,

accuracy ranged from 2% (E1-30) to 67% (E1-20). This variability may result from differences in proficiency in Spanish³⁵, since the former participant achieved 90.91% accuracy on the Spanish reading task completed on the first test, while the latter participant achieved only 50% accuracy on the Spanish reading task. Of this group of native English speakers (E1), E1-20 achieved the highest score on Test 1, with 67%, and also achieved the highest scores of the group on Tests 2 and 3, with 71% and 79%, respectively. While gains for this participant may not have been great from test to test, his scores did increase, nevertheless.

Of the other 26 participants in this group, 11 had scores that remained the same or increased from one test to another. The other 15 participants had different combinations of increases and decreases between tests (e.g., an increase from Test 1 to Test 2, and a decrease from Test 2 to Test 3; a decrease from Test 1 to Test 2, followed by an increase between Tests 2 and 3; and so on.). Differences between scores for Tests 1 and 3 were both positive and negative: E1-18, for instance, increased from 19% on Test 1 to 63% on Test 3, while E1-24 decreased from 35% on Test 1 to 21% on Test 3. These fluctuations in scores between tests are reflected in all of the language groups. Of the 52 participants, 23 consistently improved their scores on the three tests. The other participants showed various permutations of increases, decreases and equivalent scores between the three tests, which is to be expected from participants from intact classes.

3.3.2.3 Production by native English speakers with high proficiency in Spanish

The group of native English speakers with high proficiency in Spanish (E2) is interesting to consider because of the similarities and differences within the group. Four of the five participants in this group show similar levels of accuracy in the three tests with the level being

³⁵ The effect of the L1 and L2 will be discussed in detail in Chapter 4, which deals with the second research question, regarding interference.

quite low on the first test, followed by noticeable rises on the subsequent two tests: E2-10 achieved 15%, 27% and 56%; E2-12 had 8%, 31% and 46%; E2-13 obtained 8%, 42% and 65%; and E2-23 had 2%, 29% and 52%. The fifth participant (E2-26) shows a markedly different pattern of approximately half of the items produced accurately on all three tests, with accuracy levels of 52%, 54% and 52% on Tests 1, 2 and 3, respectively. An explanation for this may lie in the level of Spanish proficiency of these five individuals. The scores of the first four participants (E2-10, E2-12, E2-13 and E2-23) on the Spanish reading task given on Test 1 were all considered appropriate for proficient speakers of Spanish (100%, 90.91%, 100% and 100%, respectively), while the score for the fifth participant (E2-26) on the Spanish reading task was considerably lower (59.09%), and not at all what would be expected from a fluent Spanish speaker. It bears repeating here that the grouping of the native English speakers into E1 and E2 was based on the class in which they were enrolled – beginner Portuguese and accelerated Portuguese, respectively – and not on the information they supplied on their language background questionnaire or on their performance in the Spanish reading task on Test 1.

3.3.3 Production by Grapheme

The average accuracy on <z> items, across all participants, for Tests 1, 2 and 3 is 60%, 73% and 80%, respectively, while the average accuracy on <s> items is 17%, 26% and 30%. Production of each of the graphemes will now be discussed.

3.3.3.1 Production for grapheme <z>

It is helpful to remember that all of the participants were fluent, if not native, English speakers, enrolled in an English speaking post-secondary institution. Also, <z> in English is pronounced [z], as in Portuguese, so it is understandable that participants should perform better on <z> items than on <s> items (which may be realized as [z], [s] or [ʒ] in English, and is almost always realized as [s] in Spanish), as has already been discussed previously in this chapter.

However, it is still interesting to observe that not all participants achieve a high level of accuracy on <z> items, of which there were 19. Only six of the 52 participants achieved 100% accuracy on these tokens on Test 1, while eight did so on Test 2, increasing to 12 participants on Test 3. (Five participants achieved 100% accuracy on all three tests.) For the native English speakers with no or low proficiency in Spanish (E1), it might be expected that the scores would be consistently high, since English and Portuguese have the same correspondence rule for <z>, but this is not necessarily the case. The average levels of accuracy for group E1 were 74%, 84% and 88% on Tests 1, 2 and 3, respectively. Of the six aforementioned participants who achieved 100% accuracy on Test 1, five belong to group E1. However, there were several participants with low accuracy on this test, including E1-30 who did not produce a single <z> token correctly. One possible explanation for this lack of production of [z] lies in the participant's accuracy on the Spanish reading task: 90.91%. Although the participant was enrolled in the beginner Portuguese class, along with all of the other participants in group E1, she apparently had an excellent grasp of Spanish orthographic-phonological correspondence rules (in fact, out of all the participants in E1, she had the highest percentage of accuracy on the Spanish reading task), which seems to be the most plausible explanation for her completely inaccurate reading of the Portuguese words on the first test. Interestingly, the participant seems to have overcome this negative effect relatively well by the second and third tests, when she achieves 84% and 74% accuracy, respectively. Another anomalous participant, E1-24, had accurate production on 74% of <z> items on Test 1, then dropped to an alarming 21% (the second lowest level of accuracy in this group, on any of the tests, following the aforementioned 0% on Test 1), rising to 47% in Test 3. In this instance, however, a plausible explanation for this performance is not easily found in the participant's linguistic background, consisting of four years of Spanish in high school (accuracy of 68.18% in

the Spanish reading task), as well as three semesters of Italian in college and time spent in Italy. It is possible that this individual's three background languages (English, Spanish and Italian) interacted in such a way as to cause her confusion, and in each test she may have been testing different hypotheses with regard to the orthographic-phonological correspondence rules in Portuguese.

The native English speaking participants with high proficiency in Spanish (group E2) had lower averages on the first two tests than the other group of native English speakers (33% and 65% for E2, compared with 74% and 84% for E1), but both groups averaged roughly the same level of accuracy on Test 3 with 87% for E2 and 88% for E1. The participants with previous instruction in or exposure to Portuguese (group P) tended to achieve relatively high levels of accuracy on all the tests, averaging 77%, 83% and 89% on Tests 1, 2 and 3, respectively. This was not really unexpected, although there were two participants in this group whose performance stood out. P-1 scored low, relative to the others – 21%, 37% and 68% – which may be attributed to her native Spanish status and to reportedly little instruction in Portuguese (only five months in high school, after which the class was cancelled due to instructor illness). This participant's production was more accurate than that of most of the participants in the native Spanish group (S), which supports her classification in group P, although her level of accuracy in Portuguese was quite a bit lower than that of the other participants in this group. P-42 also had relatively low accuracy on Test 1 (37%), with close to average scores on Tests 2 and 3 (74% and 95%, respectively). The below-average score on the first test is not easily explained, as the participant claimed to be a native speaker of Portuguese and to speak the language with relatives and at home with her mother. She did not claim to have previous instruction in Portuguese, however, so

it is possible that her learning of Portuguese (including pronunciation) had never been in a formal setting where correction might be offered.³⁶

The group of native Spanish speakers (S) had lower average accuracy than any of the other groups for <z> items, on all three tests (22%, 40% and 52%, on Tests 1, 2 and 3, respectively). Two participants achieved much higher accuracy than the average on all three tests: S-19 (58%, 89% and 84%) and S-39 (95% on all three tests). There does not seem to be an immediately apparent reason why S-19 did much better than the majority of the other participants in the group. According to his language background questionnaire, he had lived in a Spanish-speaking country until the age of 5 and had completed Spanish to IB level at school. It is interesting to note that his accuracy on the English reading task on Test 1 was 100%, unlike most of his fellow native Spanish speakers. This level of accuracy in English may have had a positive effect on his production of <z> items in Portuguese, especially on the first test, when data were collected before any instruction on Portuguese pronunciation had been given in the classroom. As for participant S-39, whose scores for <z> items were consistent across all three tests, it is possible that his high accuracy in English (100% on the English reading task), coupled with four years of French in high school, positively affected his production in Portuguese.

3.3.3.2 Production for grapheme <s>

Considering the <s> items, the participants were generally less accurate on these than on the <z> items.³⁷ The highest accuracy for <s> items was 55% (S-39) on Test 1, 59% on Test 2

³⁶ After data analysis, this participant subsequently enrolled in a Portuguese class taught by the researcher, whose opinion it is that this individual was by no means a true native speaker of the language, as claimed on her language background questionnaire. The participant's accent, vocabulary and grammar were sorely lacking in comparison with what would be expected of a native speaker. Perhaps a better descriptive term for this participant would be "heritage learner," given her familial exposure to the language and yet non-native-like production.

³⁷ This probably has a lot to do with the fact that not only does intervocalic <s> in Spanish have a different phonological correspondence rule from Portuguese ([s] and [z], respectively), but in many cases <s> in English does as well. (Remember that, in English, intervocalic <s> has three possible phonological correspondences: [z] as in

(E1-20 and P-29), and 79% on Test 3 (S-37). With this 79% accuracy rate as the highest on <s> items, it is clear that no participant came close to achieving full accuracy on any of the three tests, while for <z> items, there were 25 instances of participants achieving 100% accuracy.

There are a few interesting observations to be made regarding production on <s> items. Group P averaged higher accuracy on the three tests than the other three groups, and group S tended to have very low accuracy (about a third of the scores for S were zero). S-16 had 0% accuracy for <s> on all three tests, S-4 achieved one correct token on the first test (3% accuracy) but none on the second and third tests, and S-3 had 0% accuracy on the first two tests and then 7% (2 correct items) on the third test. These low-scoring tendencies are not observed in any of the other groups, but there are two participants whose accuracy levels of 0%, 0% and 10% (E1-27), and 0%, 3% and 17% (E1-28) are somewhat surprising. It is noteworthy that these two participants (twin sisters) reported exposure to Spanish “all through school” and “K-IB,” respectively, and achieved 81.82% and 86.36% accuracy on the Spanish reading task. This may account for production which is more similar to that of the native Spanish speakers than that of the other native English speakers (from both groups E1 and E2). Interestingly, these two participants did not score particularly low on <z> items, suggesting that their proficiency in Spanish played a greater role with <s> items than with <z> items.

This closer examination of the variation in production by individuals and groups in this section has complemented the statistical results given in the previous section. The two have shown general progress by the participants in their production of the target Portuguese sounds,

raisin, [s] as in *basin*, and [ʒ] as in *Asian*.) Without examining specific word types at this point, it is not possible to identify participants' performance on the <s> tokens found in cognate words where English would have different phonological realizations. Hence, the present discussion will consider only overall accuracy on <s> items, and the more detailed discussion, taking word types into account, will follow in Chapter 5.

while also illustrating that there is still room for improvement by all participants for one or both graphemes.

3.4 Summary

With the original research questions on error resolution in mind, the results presented in this chapter supported Major's (2001) OPM, which predicts that the idealized learner's IL will move towards an end state consisting solely of L3. While such an end point was not achieved by this group of learners as a whole, given that overall accuracy at Test 3 was 50%, there was evidence to show significant progress between tests.

In terms of differences between participant groups, the prediction that the more proficient Spanish speakers would have greater difficulty with acquisition of the Portuguese GPCRs was partially supported. Certainly the native Spanish speakers tended to produce the target Portuguese sounds less accurately than the native English speakers with low proficiency in Spanish. However, the native English speakers with high proficiency in Spanish only tended to have less accuracy in Portuguese pronunciation initially, and by the end of the semester their level of accuracy was not significantly different from that of any of the other groups.

With respect to the differences between the two graphemes in question, the hypothesis that there would be significant increases between tests for both graphemes was not supported, as the test by grapheme interaction was found not to be significant. However, the prediction that learners would have different levels of accuracy for the two graphemes was supported, with <z> produced significantly more accurately than <s> by all participant groups. Thus, not only was evidence found to support the literature that shows the persistent problem that Spanish speakers have in devoicing Portuguese <s>, but evidence was found to show that English speakers also appear to have this problem.

In the examination of individual variation, disparity in production was found within and across all groups, as well as increases and decreases from one test to another. No participant achieved 100% accuracy on all items for any test, although some participants did correctly produce all <z> items in the three tests. Items with intervocalic <s> appeared to be more problematic for participants, most likely due to interference from their L1 and L2, a discussion which will be taken up in detail in the next chapter.

Table 3-1. Number and percentage of correct items for all [z], by test

Production	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %
All [z]	845	33.85	1118	44.79	1244	49.84

Table 3-2. Participant groups

Group	Group Description	No.
E1	Native English speakers with no/low proficiency in Spanish (beginner class)	21
E2	Native English speakers with high proficiency in Spanish (accelerated class)	4
P	Participants with previous exposure to or instruction in Portuguese	9
O	Participants with exposure to or instruction in other foreign languages	9
S	Native Spanish speakers	9

Table 3-3. Number and percentage of correct items for all [z], by group and test

Group	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %
E1	430	42.66	518	51.39	513	50.89
E2	37	19.27	73	38.02	108	56.25
O	127	29.40	197	45.60	246	56.94
P	210	48.61	243	56.25	274	63.43
S	41	9.49	87	20.14	103	23.84

Table 3-4. ANOVA for all production

Effect	Num DF	F Value	P value
group	4	13.71	*<.0001
test	2	93.03	*<.0001
grapheme	1	1091.61	*<.0001
word type	2	7.66	*0.0005
group*test	8	6.84	*<.0001
group*grapheme	4	44.46	*<.0001
group*word type	8	1.07	0.3808
test*grapheme	2	4.73	*0.0091
test*word type	4	0.68	0.6093
grapheme*word type	2	4.88	*0.0078
group*test*grapheme	8	1.88	0.0596
group*test*word type	16	0.64	0.8556
test*grapheme*word type	4	0.80	0.5255
group*test*grapheme*word type	24	0.79	0.7477

Table 3-5. Revised participant groups

Group	Group Description	No.
E1	Native English speakers with no/low proficiency in Spanish (beginner class)	25
E2	Native English speakers with high proficiency in Spanish (accelerated class)	5
P	Participants with previous exposure to or instruction in Portuguese	9
S	Native Spanish speakers	11

Table 3-6. Number and percentage of correct items for all [z], by revised group and test

Group	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %
E1	516	39.81	653	50.39	667	51.47
E2	41	17.08	88	36.67	130	54.17
P	210	48.61	243	56.25	274	63.43
S	78	14.77	134	25.38	173	32.77

Table 3-7. ANOVA for all production (revised groups)

Effect	Num DF	F Value	p-value
group	3	80.55	*<.0001
test	2	53.73	*<.0001
grapheme	1	616.02	*<.0001
word type	2	3.29	*0.0378
group*test	6	3.95	*0.0007
group*grapheme	3	33.38	*<.0001
group*word type	6	0.68	0.6622
test*grapheme	2	2.92	0.0547
test*word type	4	0.38	0.8242
grapheme*word type	2	3.01	0.0500
group*test*grapheme	6	1.47	0.1853
group*test*word type	12	0.30	0.9900
test*grapheme*word type	4	0.66	0.6171
group*test*grapheme*word type	18	0.57	0.9241

Table 3-8. Significant differences found between tests, by group

Group	Tests 1 & 2	Tests 1 & 3	Tests 2 & 3
E1	*<.0001	*<.0001	
E2	*0.0004	*<.0001	*0.0014
P		*0.0003	
S	*0.0093	*<.0001	

Table 3-9. Significant differences found between groups, by test

	E1	E2	P	S
E1		0.0452 (Test 1)		<.0001 (Test 1) <.0001 (Test 2) 0.0198 (Test 3)
E2			0.0096 (Test 1)	
P				<.0001 (Test 1) 0.0002 (Test 2) 0.0004 (Test 3)
S				

Table 3-10. Number and percentage of correct items, by grapheme and group

Group	<z> #	<z> %	<s> #	<s> %
E1	1261	82	575	24
E2	176	62	83	19
P	426	83	301	38
S	237	38	148	15

Table 3-11. Production of [z] by native Spanish speakers in English reading task

No.	Background in Spanish	English	Portuguese
1	Dominican Rep.; Miami; Span. classes in middle school and HS	7	44%
2	Colombia	0	35%
3	Up to IB in HS; relatives	6	17%
4	From Venezuela	0	10%
16	K-10; El Salvador till 15	0	4%
19	Venezuela till 5; IB Spanish	8	65%
37	K-12, Colombia	6	83%
39	4314 (advanced Spanish class at university); Mexico for 2 yrs	8	71%
43	Graduated HS in Colombia	1	19%
45	Since 5th grade	8	23%
48	Bolivia for 14 yrs	8	25%
50	Studied for 6 yrs; Colombia	2	46%

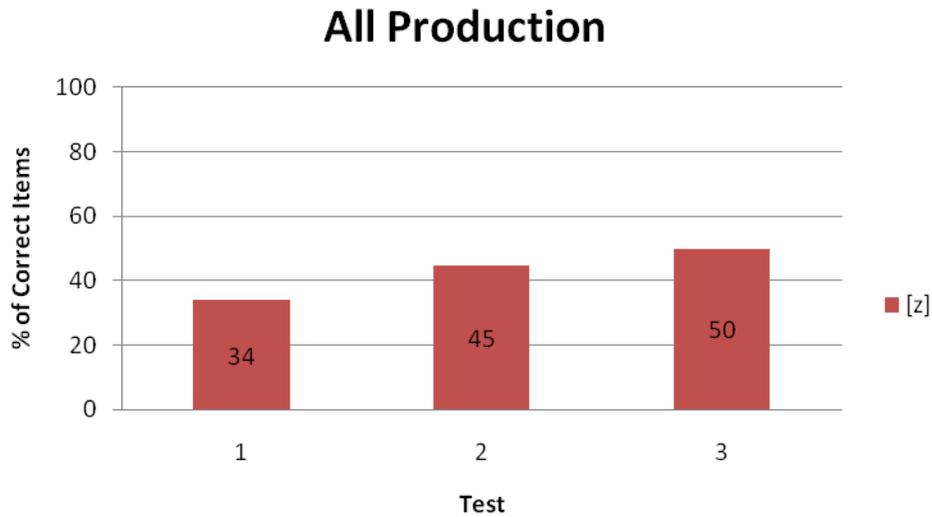


Figure 3-1. Percentage of correct items by test

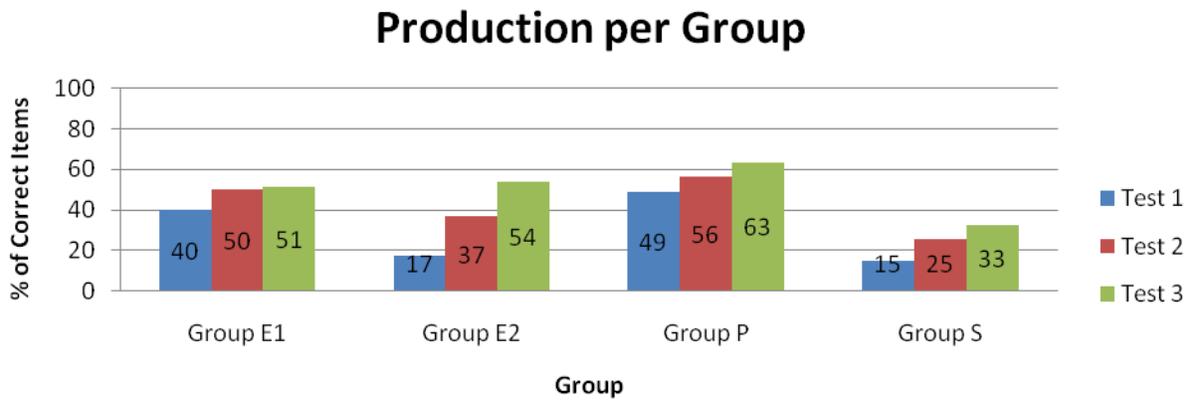


Figure 3-2. Percentage of correct items, by test for each group

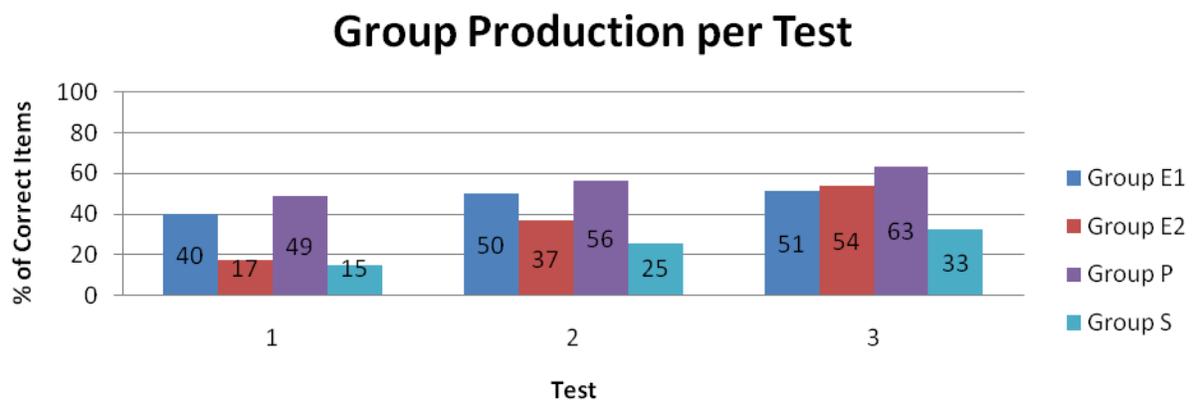


Figure 3-3. Percentage of correct items, by group for each test

Grapheme Differences per Group

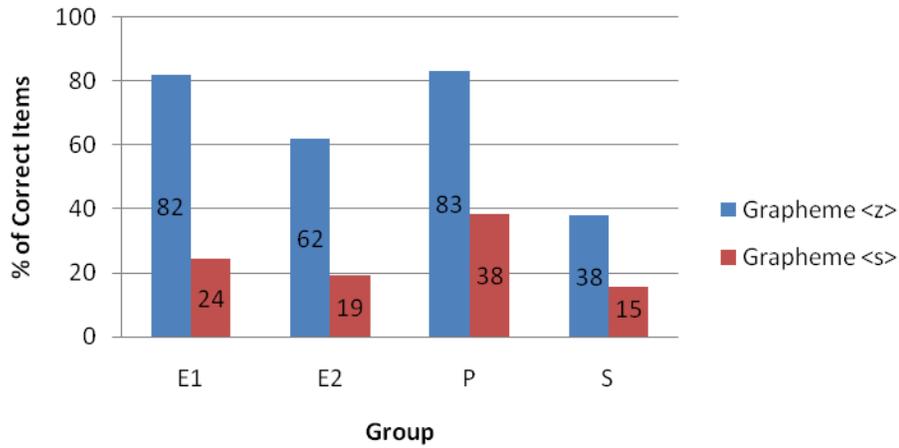


Figure 3-4. Percentage of correct items, by grapheme for each group

Group Differences per Grapheme

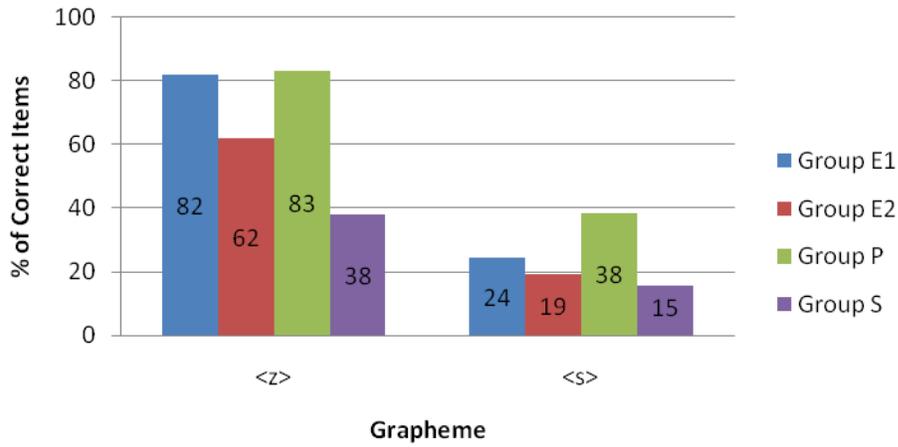


Figure 3-5. Percentage of correct items, by group for each grapheme

CHAPTER 4 INTERFERENCE – RESULTS AND DISCUSSION

4.1 Introduction

This chapter addresses the second overarching research question, which asked about the role of interference, or language transfer, in acquisition. Before presenting and discussing the relevant results, it is helpful to recall the research questions asked and hypotheses stated (in section 2.2.2) concerning interference. The first question asked what evidence there was of interference from the L1 and/or the L2, and predicted, according to Major's (2001) OPM, that there would be evidence of interference from both the L1 and the L2, with these reducing over time. It was also expected, given the U component in the model, that there would be evidence of production which was not consistent with the grammars of the L1, the L2 or the L3.

The second question considered whether there would be differences in interference between participant groups, and it was anticipated that the different groups would show varying degrees of transfer from English and Spanish, depending on their native language and on their level of proficiency in Spanish. It was predicted that native English speakers with low or no proficiency in Spanish would show greater transfer from English (at least initially), while native English speakers with high proficiency in Spanish and native Spanish speakers would show significant transfer from Spanish (at least initially), due to their greater experience with a language more closely related to Portuguese than English. Thus, the prediction was that the more typologically similar language, Spanish, would be the basis of transfer where proficiency in that language was high, while English would be the basis of transfer where proficiency in Spanish was lower, according to Hammerberg's (2001) belief that there must be a certain level of proficiency in the L2 in order for it to be a basis of transfer to the L3, and according to findings in the literature regarding the facilitation of transfer between similar languages.

The third question explored whether differences in interference existed between the two graphemes <z> and <s>, and it was hypothesized that there would indeed be differences due to the GPCRs of English, Spanish and Portuguese for the two graphemes in question. Furthermore, it was predicted, according to Muller and Muller's (1968) observations, that the more difficult Portuguese GPCR to acquire would be the <s>-[z] one, since it is different from (most of) the GPCRs in Spanish and English for intervocalic <s> (although English does have the <s>-[z] correspondence rule for some lexical items), and Portuguese <z>-[z] would be easier to acquire since English has the same rule. Thus, evidence of positive transfer from English (or acquisition of Portuguese) was expected for <z>, while evidence of negative transfer from English and/or Spanish was expected for <s>.

The final question explored the extent to which accuracy of production in Spanish could be said to be related to acquisition (correct production) of Portuguese. It was expected, based on the researcher's own classroom-motivated impressions, as well as observations in the literature regarding the difficulties encountered by Spanish speakers learning Portuguese pronunciation, that there would be an inverse relationship between accuracy of production in Spanish and production of the Portuguese GPCRs in question. That is, it was predicted that the greater the proficiency in Spanish (as measured by accuracy in production in the Spanish reading task), the lower the accuracy in production in Portuguese would be.

The results will be presented and discussed by grapheme and participant group. Following will be an analysis of participants' production in the Spanish reading task on the first test, compared to their production in the Portuguese reading tasks.³⁸ In the section with other

³⁸ Production according to word type (cognate, non-cognate and nonce) will be discussed in Chapter 5, which addresses the third research question, about generalizability.

observations, production of individual participants and words will be examined, and finally the chapter's results will be summarized.

4.2 Results and Discussion

Seven production types were possible for grapheme <s>, while only four were possible for grapheme <z>. Hence, the results for the two graphemes are presented and discussed separately.

4.2.1 Production for Grapheme <s>

Results are presented in terms of raw production scores, percentages of items for each production type (out of all items on a test), and statistically significant differences (output from the model), which are marked with an asterisk in the tables. For <s>, seven production types were possible: EN, EP, ES, NO, OTH, PO and SP.

The first, coded as EN (English), represents [ʒ], and it could occur when the English pronunciation rule differed from the Spanish and Portuguese rules. Its occurrence was logically limited to the six cognate <s> words where the English equivalent would be pronounced with [ʒ]³⁹, and it was taken to indicate evidence of negative transfer from English.

The second production type, coded as EP (English Portuguese), represents [z], occurring when the English and Portuguese pronunciation rules coincided with each other but differed from Spanish. This production type was limited to the five cognate <s> words where the English equivalent would be pronounced with [z]⁴⁰, and it was considered to be indicative of positive transfer from English and/or acquisition of Portuguese.

The third type of production, coded as ES (English Spanish), represents [s], occurring when the English and Spanish pronunciation rules coincided with each other but differed from

³⁹ *Audiovisual* (“audiovisual”), *decisão* (“decision”), *divisões* (“division”), *revisão* (“revision”), *televisão* (“television”), *visão* (“vision”).

⁴⁰ *Apresentação* (“presentation”), *esquisito* (a false cognate meaning “odd”), *museu* (“museum”), *presidente* (“president”), *visível* (“visible”).

target Portuguese. This production type was possible for 18 words: the six cognate <s> words where the English equivalent would be pronounced with [s]⁴¹, the six non-cognate <s> words and the six nonce <s> words⁴². This production type suggested negative transfer from English and/or Spanish.

The fourth production type, coded as PO (Portuguese), represents [z], and it was possible when the Portuguese rule differed from the English and Spanish rule(s). This was possible for 24 words: the six cognate <s> words which would be pronounced with [ʒ] in English and with [s] in Spanish, the six cognate <s> words which would be pronounced with [s] in both English and Spanish, the six non-cognate <s> words, and the six nonce <s> words. This production type would indicate evidence of acquisition of Portuguese pronunciation rules, rather than interference from English or Spanish.

The fifth production type, coded as SP (Spanish), represents [s], and it could occur when the Spanish rule differed from the English and Portuguese rule(s). This was possible for 11 words: the five cognate <s> words which would be pronounced with [s] in Spanish but with [z] in English and Portuguese, and the six cognate <s> words which would be pronounced with [s] in Spanish but with [ʒ] in English and with [z] in Portuguese.

The final two types of production possible were when participants produced nothing for the target grapheme (coded as NO), as a result of a misread word, a skipped syllable or a skipped word, or when participants produced another sound (coded as OTH), which was unexpected

⁴¹ Básico (“basic”), casos (“cases”), curiosidade (“curiosity”), filosofia (“philosophy”), generosidade (“generosity”), persuasivo (“persuasive”).

⁴² The “default” pronunciation for <s> in English was assumed to be [s], since this is the sound that occurs in most of the contexts where the grapheme <s> appears, while pronunciation of <s> as [z] or [ʒ] in English is idiosyncratic and must be learned. Thus, it was assumed that if participants transferred English pronunciation rules, the <s> in the Portuguese non-cognate and nonce words would be pronounced as [s], since these words should not have triggered any idiosyncratic pronunciation from English as cognate <s> words with [z] and [ʒ] in English might have done.

given the pronunciation rules of English, Spanish and Portuguese for intervocalic <s>. These two production types, logically, could occur for any of the 29 <s> items.

All the sounds produced for <s> words were coded (according to the seven production types), and the codes summed for each test. These sums (raw scores) were then converted to percentages, with these adding up to 100% for each test (Table 4-1), and grouped according to production type for graphic representation (Figure 4-1).

Numerically, slight increases were seen in correct production of <s> as [z] (EP, PO) throughout the semester and slight decreases in incorrect production of <s> as [s] (ES, SP), though there was no decrease of <s> as [ʒ]. Negative transfer (EN, ES and SP) accounted for approximately 81% of the total production on the first test, 73% on the second test, and 69% on the third test. Positive transfer and/or acquisition (EP and PO), on the other hand, accounted for roughly 17% on Test 1, 27% on Test 2, and 30% on Test 3. (NO and OTH accounted for the rest of the production, adding up to only approximately 1% on each of the three tests.) The ANOVA results (Table 4-2) indicated that production type was a significant factor, and significant interactions were found between production type and test, and between production type and participant group.

4.2.1.1 Production for grapheme <s> by production type and test

Tukey post-hoc t-tests revealed a number of significant differences on Test 1 (Table 4-3), Test 2 (Table 4-4) and Test 3 (Table 4-5). Not all of the differences shown to be significant are actually interesting to consider, given that different production types could logically occur for different sets of words. The noteworthy comparisons, here and throughout this chapter, are between production types EP and SP, and ES and PO (marked with ⁺ in the tables). The comparison between EP and SP is interesting to consider because these two production types are essentially two sides of the same coin, so to speak. The same can be said for the comparison

between ES and PO. In the first, where English and Portuguese rules coincide (EP), they differ from the Spanish rule (SP); in the second, where English and Spanish rules coincide (ES), they differ from the Portuguese rule (PO). Thus, in each pair, there is a production type that corresponds to correct production (EP and PO, respectively) and one that corresponds to incorrect production (SP and ES, respectively), as far as target Portuguese is concerned.

There were significant differences found between production types EP and SP on all three tests: SP (347 tokens) differed significantly from EP (113 tokens) on Test 1 ($p < .0001$); SP (279 tokens) occurred significantly more than EP (148 tokens) on Test 2 ($p < .0001$); and SP (275 tokens) differed significantly from EP (146 tokens) on Test 3 ($p < .0001$). On all three tests, transfer from Spanish was greater than transfer from English/correct Portuguese production. Additionally, there were no significant differences for EP production between tests, nor for SP production between tests. This suggests that, for <s> words where the Spanish rule would produce something different from the English and/or Portuguese rules, participants were mainly employing the Spanish rule, incorrectly producing [s], and this remained relatively constant throughout the semester.

Examining the production types ES and PO, the picture is quite similar. Negative transfer from English and/or Spanish (ES) was consistently higher than correct Portuguese production (PO) for the relevant words. In the interactions on all three tests, the difference between these two types of production was statistically significant ($p < .0001$). There were, however, significant differences between tests for these two production types. ES showed a significant decrease from Test 1 to Test 2 ($p = 0.0304$), and between Test 1 and Test 3 ($p < .0001$), while there was a significant increase for PO from Test 1 to Test 2 ($p = 0.0001$), and between Tests 1 and 3 ($p < .0001$). When the correspondence rules in the learners' L1 and L2 coincided, but differed

from the L3 rule, negative transfer from the L1 and L2 abounded. Although there was a significant decrease in the negative transfer and a significant increase in target Portuguese production between the first two tests, no significant gains were made between Tests 2 and 3, suggesting that learners require a good deal more exposure to Portuguese and instruction in pronunciation to overcome the hindrances posed by the L1 and L2, or they fossilize incorrect correspondence rules fairly early on (between Tests 2 and 3). Obviously, longer term studies are necessary in order to discover the extent of interference from the L1 and L2.

4.2.1.2 Production for grapheme <s> by production type and group

Considering the production type by group interaction for <s>, those comparisons to be discussed are between participant groups for the same production type (e.g., groups E1 and E2 for type EP), and between different production types for the same group (e.g., EP and SP for group E1). The production types for each language group were summed for all three tests (raw scores) and then calculated as percentages of the total production⁴³, such that each group's production adds up to 100% (Table 4-6). These results are also shown graphically for the four participant groups (Figure 4-2).

Tukey post-hoc t-tests were carried out, and a number of significant differences were found. These results are given first according to production type for all groups. No significant differences between groups were found for production types EN, NO or OTH; the production types found to have significant inter-group differences were EP, ES, PO and SP. For production type EP (Table 4-7), the only significant differences found were between E1 and S ($p=0.0137$) and between P and S ($p=0.0104$). Recalling that EP is the production type that occurs when English and Portuguese rules coincide (but differ from the Spanish rule), and remembering that

⁴³ Raw scores and percentages are not shown for each test because the ANOVA did not find the three-way interaction between test, production type and group to be significant.

E1 is the group of native English speakers with low or no proficiency in Spanish, and P is the group of participants with previous instruction in Portuguese (most of whom would be in E1 were it not for their prior exposure to Portuguese), it is perhaps to be expected that these significant differences should exist. This seems to suggest that groups E1 and P are transferring from English on these words (or showing acquisition of the Portuguese rule) more than group S does. It is also noteworthy that there were no significant differences between group E2 and any of the other groups. It would seem that the overall production of this group falls sufficiently between that of groups E1 and P (on the high end) and group S (on the low end) to render any differences insignificant.⁴⁴

Production type ES (Table 4-8) shows group P differing significantly from groups E1 ($p=0.0005$) and S ($p=0.0013$). Given what was found for production type EP, it would not be illogical to assume that group E1 participants are transferring mainly from English where ES occurs for them, and S participants are most likely still transferring from Spanish in instances where ES occurs. What is interesting, again, is that there were no significant differences found between E2 and the other groups. Recalling the percentages for ES production for the different groups (Table 4-6 and Figure 4-2), it is clear that P showed the least amount of interference from English and/or Spanish on the words where the English and Spanish rules coincided (but differed from the Portuguese rule). S showed the greatest amount of interference (presumably mainly from Spanish), E1 showed the second highest amount of interference (believed to be primarily from English), and E2 production was between E1 and P in terms of interference. This seems to suggest that previous Portuguese has indeed been a help to group P in terms of enabling correct

⁴⁴ This result might be explained somewhat if test were considered, as the production of E2 more closely resembled that of S initially, while later on E2 production was more similar to that of groups E1 and P.

production of Portuguese, and for some reason group E2 also seems to be at less of a disadvantage than E1 and P when it comes to the hindrance caused by the L1 and/or L2.

Production type PO (Table 4-9), which is approximately the counterpart of ES, showed significant differences between group P and the other three groups ($p < .0001$). This is an interesting result, for two principal reasons. First, it validates the creation of a separate group for those with previous instruction in Portuguese, in that these participants differed significantly from the other groups in their production (at least of <s> items). Second, it suggests that instruction in Portuguese does make a difference when it comes to acquisition of pronunciation rules. Group P significantly outperformed the other three groups (the percentage for P on this production type was almost double the percentage of the next highest group), demonstrating better production of the Portuguese correspondence rule for intervocalic <s> than was found with the other groups. (The fact that there is a statistical difference seen here for group P which was not observed in the previous chapter, concerning error resolution, is due to the fact that here the data are broken down further than in the previous chapter, into different possible production types, allowing a more detailed perspective on what different participant groups are producing in different contexts.)

Differences on the last production type, SP (Table 4-10), the approximate counterpart of EP, showed those groups consisting primarily of native English speakers with low or no Spanish proficiency (E1 and P) differing from those groups with proficient Spanish participants (E2 and S). These results would seem to indicate that E1, P and S are transferring significantly from their L1 (English for E1 and P, and Spanish for S), while E2 seems to be transferring significantly from the L2 (Spanish). This would indicate that where proficiency in the typologically more similar language (here, Spanish) is higher, transfer from that language (be it from the L1 or L2)

to the L3 is higher, suggesting that in the acquisition of related languages, typological similarity or relatedness is more important than language status (L1/L2).

Consideration will now be given to comparisons between different types of production within each of the four participant groups. Those comparisons of interest (marked with ⁺ in the tables) are EP-SP and ES-PO. For group E1 (Table 4-11), there were significant differences for the two key comparisons – EP-SP and ES-PO (for both, $p < .0001$). ES production was significantly greater than PO production. While this finding is not particularly unexpected, given that ES is indicative of transfer from English and/or Spanish (the L1 and/or the L2), it is noteworthy that SP production was significantly greater than EP production, which indicates negative interference from Spanish (this group's L2).

Group E2 (Table 4-12) also had significantly greater SP production than EP production ($p < .0001$), suggestive of more negative transfer from Spanish than positive transfer from English (and/or acquisition of the Portuguese rule). Additionally, this group showed significantly greater production of ES than PO ($p < .0001$), with negative transfer from English and/or Spanish occurring more often than target Portuguese production.

For group P (Table 4-13), there was no significant difference between EP and SP ($p = 1.0000$), indicating that positive transfer from English (and/or acquisition of the Portuguese rule) and negative transfer from Spanish were roughly equivalent for the relevant words. However, as for groups E1 and E2, there was a significant difference between ES and PO ($p < .0001$). Although group P showed a great deal more of production type PO than did the other groups, the fact remains that negative transfer from English and/or Spanish was still occurring abundantly, even for the group with previous instruction in Portuguese.

Group S (Table 4-14) showed significant differences on both of the comparisons under consideration (EP-SP and ES-PO). In both cases, S showed more negative transfer from Spanish (SP and ES) than positive transfer from English and/or target Portuguese pronunciation (EP and PO). Given that this is the group of native Spanish speakers, it is not unexpected that the bulk of their production should show transfer from Spanish (or possibly English, for production types ES and EP). It is encouraging, though, that they achieve some target Portuguese pronunciation (evidenced clearly by production type PO).

4.2.2 Production for Grapheme <z>

With these findings for the grapheme <s> in mind, production for the grapheme <z> will be examined in this section. Results are presented in terms of raw production scores, percentages of items for each production type (out of all items on a test), and statistically significant differences (output from the model), which are marked with an asterisk in the tables. For this grapheme, there was a reduced number of possible production types, since English and Portuguese orthographic-phonological rules always coincide to produce [z], and Spanish always differs, with its rule of <z>-[s] (or <z>-[θ] in Peninsular Spanish).⁴⁵

There were, therefore, four possible production types for this grapheme: EP, NO, OTH, and SP. All four of these types could occur on all of the 19 <z> words, as participants produced a sound expected according to the English and/or Portuguese phonological systems (EP), according to the phonological system of Spanish (SP), according to none of the three systems (OTH), or no sound at all for the target grapheme (NO). All the sounds produced were coded according to these four production types, and the codes summed for each test. These sums (raw

⁴⁵ The voiceless interdental fricative [θ] was produced for <z> by only one participant, for three different words on the first test; all were allocated the production code SP.

scores) were then converted to percentages, with these adding up to 100% on each test (Table 4-15), and grouped according to production type for graphic representation (Figure 4-3).

Numerically, increases in correct production of <z> as [z] (EP) were seen throughout the semester, as were decreases in incorrect production of <z> as [s] (SP), while the marginal occurrences of NO and OTH remained roughly the same across all three tests (1-2% for each type). Negative transfer from Spanish (SP) accounted for 37% of the total production on the first test, 23% on the second test, and 16% on the third test. Target Portuguese (EP), on the other hand, accounted for 60% on Test 1, 73% on Test 2, and 80% on Test 3. (NO and OTH accounted for the rest of the production, with both types adding up to approximately 3% on Tests 1 and 3, and 4% on Test 2.)

The ANOVA results (Table 4-16) indicated that production type was a significant factor, and the interaction between production type and test was significant, as was the interaction between production type and participant group. The interaction between group and test was not found to be significant, but the three-way interaction between group, test and production type was significant for <z>. Tukey post-hoc t-tests revealed a number of significant differences on Test 1 (Table 4-17), Test 2 (Table 4-18) and Test 3 (Table 4-19). Those comparisons of interest are between production types EP and SP (marked with ⁺ in the tables).

Despite what appears to be a sizeable numerical difference between EP and SP on the first test, no statistically significant difference was found between these production types. However, they did differ from each other on Tests 2 and 3 ($p < .0001$), with EP occurring significantly more than SP. These results suggest that there was no statistically significant difference between transfer from English and transfer from Spanish before instruction in Portuguese (i.e., at Test 1),

but once instruction took place, negative transfer from Spanish decreased while acquisition of Portuguese GPCRs increased (possibly facilitated by positive transfer from English).

Between tests, there were some significant differences found for EP: between Tests 1 and 2 ($p=0.0006$), and between Tests 1 and 3 ($p<.0001$). However, there was no significant difference found between Tests 2 and 3 ($p=0.1343$), suggesting that greater gains were made earlier in the semester. The pattern was similar for SP, with significant differences between Tests 1 and 2 ($p=0.0009$), and between Tests 1 and 3 ($p<.0001$), but no significant difference between Tests 2 and 3 ($p=0.1242$), indicating that negative transfer decreased more markedly at the beginning of the semester. Although instruction was not a factor that was specifically taken into account in this study, it does seem to have had an effect.

4.2.2.1 Production for grapheme <z> by group and type

Considering the interaction between participant group and production type, the comparisons of interest are between groups for the same production type (e.g., groups E1 and E2 for type EP), and comparisons between different production types for the same group (e.g., EP and SP for group E1). The production types for each group were summed for all three tests (raw scores) and then calculated as percentages of the total production, such that each group's production adds up to 100% (Table 4-20). These results are also shown graphically for the four participant groups (Figure 4-4).

Tukey post-hoc t-tests were carried out to determine where the significant differences could be found. These results are given first according to production type for all groups. No significant differences between groups were found for production types NO or OTH; the production types to have significant inter-group differences were EP and SP. For production type EP (Table 4-21), there were a number of significant differences to be considered. In fact, the only inter-group difference which was found not to have statistical significance was the one

between E1 and P. Recalling that most of the participants in group P (with previous instruction in Portuguese) would otherwise have been included in group E1, it is perhaps not unexpected that their production should be similar when considered across all three tests. It is also perhaps not unexpected that these two groups should behave differently from the groups of speakers proficient in Spanish (E2 and S). It is noteworthy that the two groups of Spanish speakers, however, should differ significantly from each other. It seems that the different L1s of these two groups may have played a role in their Portuguese production, despite the similarity they shared in their proficiency in Spanish.

For production type SP (Table 4-22) the only inter-group difference that was not statistically significant was that found between groups E1 and P. Again, it seems reasonable that these two groups, comprised primarily of native English speakers with low or no proficiency in Spanish, should have less negative transfer from Spanish than the other groups, comprised of proficient Spanish speakers. It is also worth highlighting that a significant difference was found between the two groups of proficient Spanish speakers (E2 and S), where the native Spanish speakers showed more negative transfer from Spanish than did the non-native Spanish speakers.

Consideration will now be given to comparisons between different types of production within each of the four participant groups. The noteworthy comparisons (EP-SP) are again marked with ⁺ in the tables. The EP-SP comparison showed statistically significant differences for all of the participant groups. However, the differences were not the same for all groups. That is, for groups E1 (Table 4-23), E2 (Table 4-24) and P (Table 4-25), production of EP was significantly greater than production of SP, while for group S (Table 4-26), the reverse was true – production type SP occurred significantly more often than production type EP. Thus, it seems that the L1 was an important factor when it came to production: for those groups where the L1

was primarily English (E1, E2 and P), target Portuguese exceeded negative transfer from Spanish for <z> (perhaps facilitated by the possibility of positive transfer from English), while the group of participants whose L1 was Spanish transferred principally from Spanish for <z> (from where there would be no possibility of positive transfer to L3 Portuguese).

These results may be somewhat oversimplified, however, when test is not taken into account. Thus, it is necessary to examine the three-way interaction of group, production type and test.

4.2.2.2 Production for grapheme <z> by group, type and test

For each participant group, raw scores were summed for each production type and test, and percentages were calculated, with each group's production for each test adding up to 100% (Table 4-27)⁴⁶. For ease of reading, tests are indicated in parentheses. As would be hoped for language learners, there were increases in target production of [z] (EP) and decreases in incorrect production of [s] (SP) across all groups, between all tests. As is to be expected, groups differed in the proportions of their production, and post-hoc Tukey tests revealed those differences which were statistically significant for EP and SP. (Test times are shown in parentheses.)

For production type EP (Table 4-28), there were a number of significant differences on the first test. Groups E1 and P differed significantly from groups E2 and S, but not from each other, nor did E2 and S differ significantly from each other. That is, the two groups of primarily native English speakers (E1 and P) were seen to differ from the two groups of proficient Spanish speakers (E2 and S), but the groups within the pairs did not differ significantly from each other. By Test 2, the picture was slightly different: E1 and P still differed significantly from S, but they no longer differed significantly from E2; and E2 continued not to differ significantly from S.

⁴⁶ Production for NO and OTH is not shown, for the sake of simplicity, since there were no significance differences between groups or tests for these production types.

This would seem to indicate that the production of E2 was somewhere in the middle in terms of accuracy: it was not quite as accurate as E1 and P, but it was also not quite as inaccurate as S. This progression continued to Test 3: E1 and P remained significantly different from S and there continued to be no significant difference between E1, P and E2, but at this test E2 differed significantly from S. These results would suggest that native English speakers proficient in Spanish (E2) behave more like native Spanish speakers (S) initially than like native English speakers with no or low proficiency in Spanish (E1). However, by the end of the semester, the E2 participants largely overcame the negative transfer from Spanish, at least to the same extent as the native English speakers in E2 (and P). The native Spanish speakers in S, however, did not seem as capable of overcoming the negative transfer from Spanish as the native English speakers proficient in Spanish in E2, suggesting that the L1 may be more involved in determining acquisition of the Portuguese GPCR <z>-[z] than proficiency in a typologically similar language.

For production type SP (Table 4-29), there was roughly the same significance pattern as for EP, albeit with the raw scores and percentages decreasing for SP where they increased for EP. The only divergence from the previous pattern was that for SP there was no significant difference between groups E2 and S on Test 3 (although it approached significance at $p=0.0752$). The reason for this non-significant difference is unclear, given that there was a significant difference found between E2 and S on Test 3 for production type EP, but it may be related to the relatively small number of participants in group E2.

Between tests, only four significant differences occurred. For group E2, there were significant differences between Tests 1 and 3 for production type EP ($p<.0001$) and for type SP ($p=0.0008$). For group S, there were significant differences between Tests 1 and 3 for production type EP ($p=0.0132$) and for type SP ($p=0.0055$). In the case of both groups, EP

production increased and SP production decreased. These results show that, for <z>, groups E1 and P started out with a relatively high level of accuracy, whether due to previous Portuguese instruction (for P) or due to the orthographic-phonological rule <z>-[z] that is shared by English and Portuguese, allowing for the possibility of positive transfer from English in the case of these items. Due to this relatively high level of accuracy to begin with, it is not entirely unexpected that there should be no great gains made by these groups for <z>. Also, it is perhaps to be expected that the other two groups, E2 and S, should display lower levels of accuracy initially, given their proficiency in Spanish and the typological similarity between Spanish and Portuguese. It is encouraging, then, to see both of the latter groups making significant gains in accuracy by the end of the semester.

4.2.3 Relationship between Spanish Production and Portuguese Production

In this section, the results of the Spanish reading task given at Test 1 are considered in relation to Portuguese production, in order to examine the hypothesis that accuracy of production in Spanish is inversely related to accuracy of production in Portuguese. The results (Appendix J) are presented in ascending order, according to level of accuracy on the Spanish reading task. A comparison between production on the Spanish reading task and an average of the Portuguese production on the three tests is shown graphically in Figure 4-5. (Production on the Spanish reading task was first compared to each of the three Portuguese tests separately, but statistical tests did not reveal any significant differences between the three comparisons, so it was decided to calculate an average of the participants' production on the Portuguese tests and use that average as a basis for comparison with the production on the Spanish task.)

A regression model was used to analyze these results, in order to determine the relationship between participants' production on the Spanish reading task and production on the three Portuguese reading tasks. The results of the regression model are shown in Figure 4-6. The slope relating Spanish to Portuguese is negative; that is, there is a negative relationship between accuracy in Spanish and accuracy in Portuguese. In other words, the greater the accuracy in Spanish was, the lower the accuracy in Portuguese was. This pattern appears to suggest that accuracy in Spanish pronunciation has a negative bearing on accuracy in Portuguese pronunciation, an observation that is corroborated by other results seen in this chapter.

4.3 Other Observations

In this section, production is considered at the level of individual participants and words. Production was summed per production type for each participant, and then percentages of possible production calculated by grapheme for each participant, such that production of grapheme <s> adds up to 100% and production of grapheme <z> adds up to 100% for each participant. These percentage results were then ordered according to the four participant groups (Appendix K).

The items of most interest to consider are those where participants produced something other than what was expected, given the pronunciation rules for <s> and <z> in English, Spanish and Portuguese. For grapheme <s>, production type OTH could logically occur on any of the 29 <s> words in each test, yet there was a relatively low proportion of OTH for most participants, where production ranged from 0% to 3% across all three tests. Two participants had greater OTH production: participant S-4, with 5%, and participant E1-14, with 8%. Participant S-4 produced the voiceless palatal fricative [ç] for two <s> words in the first test – *audiovisual* (“audiovisual”) and *televisão* (“television”), and for the same <s> word in Tests 2 and 3 – *presidente* (“president”). Participant E1-14 produced the voiceless palatal fricative [ç] for six words on the

first test – *museu* (“museum”), *visão* (“vision”), *feserel* (a nonce word), *quasano* (nonce), *casaco* (“coat”), *preguiçoso* (“lazy”) – and [sj] for one word on the first test – *decisão* (“decision”). It would seem that for the cognate words where English would have the voiced palatal fricative [ʒ], the participants were producing something approximating this sound with [ʃ] and [sj]. In the other cases, it is not clear what would have led the participants to produce the sound they did. In fact, the voiceless palatal fricative [ç] was the most common sound categorized as OTH for all of the participants, and generally occurred on cognate words where English would have the voiced palatal fricative [ʒ], though not always. Although this production type accounted for a very small proportion of the overall production, it is interesting that it is not altogether absent, supporting claims in the literature that in acquisition of a language after the L1 (i.e., L2 and beyond), elements often emerge that are not consistent with the grammar of the L1 nor with the L2 grammar (Broselow, Chen & Wang, 1998).

For grapheme <z>, production type OTH could logically occur on any of the 19 <z> words. Proportions of this production type were relatively high for <z>, compared with <s>. Two participants – E1-18 and E1-24 – produced something other than the expected phonemes for 18% of their total <z> production, which equates to roughly 10 words across the three tests. Another 18 participants also registered OTH production, with percentages ranging from 2% to 12% of their total <z> production. These other sounds tended to be the voiced palatal fricative [ʒ] or the affricate [ts], neither of which would be expected, given the pronunciation rules for <z> in English, Spanish and Portuguese. However, again, it is interesting to observe that participants did not produce just any sound in these OTH cases; rather, their production was generally some sort of approximation to the target – in the case where [ʒ] was produced instead of [z], the approximation is in place of articulation (palatal instead of alveolar) rather than voicing, as was

often observed for grapheme <s>. These observations would indicate universal tendencies toward unmarked features.

Consideration will now be given to the production of particular words. The 48 words are listed (Appendix L) along with their word type (C for cognate, N for nonce, and NC for non-cognate) and the sound expected according to English pronunciation rules (the Portuguese rules would always produce [z]; and the Spanish rules would always produce [s], or possibly [θ] for <z>). Production was summed for each word, according to production type, and percentages calculated, with production for each word totaling 100%.

For the five cognate <s> words where English would have [z], target Portuguese pronunciation (possibly due to positive English transfer) was recorded approximately half of the time for four of the words; the fifth word, *presidente* (“president”), was produced correctly on roughly two thirds of instances. It is possible that this word appeared more like the English form of the cognate than the other four words in this category, which may have led to its correct production more often. For the six cognate <s> words where English would have [s] as well as Spanish, there was an overwhelming production of [s] (close to 100%) on all but one word – *casos* (“cases”) – where incorrect [s] was produced on 73% of instances. It is possible that this word was more common in the classroom, which led to its higher correct production in comparison with the other words in this category. In the case of the six cognate <s> words where English would have [ʒ], it is interesting to find relatively low proportions of EN ([ʒ]) on all the words apart from *audiovisual* (“audiovisual”), where participants produced [ʒ] on 35% of occasions. Again, it is possible that this word was produced with English [ʒ] more often than the other words in this category due to its exact orthographic equivalence in English. It is also noteworthy that participants produced something other than what would be expected by English,

Portuguese and Spanish rules on 8% of occasions for this word. This OTH production tended to be [ʃ] which approximates the English [ʒ]. Across the words in this category, production of SP ([s]) tended to be quite a bit higher than that of PO ([z]), except in the case of *audiovisual* (“audiovisual”) and *visão* (“vision”) where production was fairly evenly split between SP and PO. For the nonce and non-cognate <s> words, participants generally produced inaccurate ES ([s]) roughly 85% of the time, although the non-cognate word *casaco* (“coat”) yielded only 70% inaccurate production. This may be due to this word being more common in the classroom than the other non-cognate words. It is interesting that the results for the non-cognate words and for the nonce words appear very similar.⁴⁷

Results for the <z> words were mixed. The percentages of accuracy ranged from 55% on the non-cognate *rapazes* (“young men”) to 86% on the cognate *horizonte* (“horizon”). The target <z> in *idealização* (“idealization”) was skipped on 15% of occasions, by far the greatest percentage of NO production for any word. Additionally, *pastiza* (nonce) and *rapazes* (“young men”) had relatively high OTH production, with 8% and 6%, respectively. The other sounds produced for these words tended to be [ʒ] and [ts], which are not attributable to Spanish or English.

4.4 Summary

With the original research questions on interference in mind, the results presented in this chapter support Major’s (2001) OPM, which predicts interference from the L1 and/or the L2 and this interference reducing over time as the L3 increases. Evidence was found for interference mainly from the L1 for groups E1 and S, while group E2 had interference from the L2. All groups tended to have increases in target Portuguese production throughout the semester,

⁴⁷ This will be discussed in greater detail in Chapter 5.

indicative of a reduction of the role of the L1/L2 and an increase in the L3 in the learners' IL. Additionally, there were occurrences of some items which were not consistent with the orthographic-phonological correspondence systems of the L1, L2 or L3. These "other" sounds (production type OTH) tended to be approximations of the sounds expected by the L1, L2 or L3 correspondence rule systems. For example, where English would have the [s]-[ʒ] rule (i.e., on words like *visual*, "visual"), the voiceless counterpart [s̥] was often produced. Rather than just being "rogue" sounds in the production, these approximations suggest evidence for the universal elements (U) predicted by the OPM, with less marked (e.g., voiceless) sounds appearing in the place of more marked (e.g., voiced) sounds.

Hammarberg (2001) proposed that for an L2 to be the basis of interference, proficiency in it would have to be relatively high. The results in this chapter support that claim to a certain extent. E2, the group of L1 English speakers highly proficient in Spanish, tended to show more interference from the L2 (at least initially) than E1, the group of L1 English speakers with no or low proficiency in Spanish. Group S, the L1 Spanish speakers, showed little evidence of clear transfer from the L2, however; their transfer tended to be from the L1, even though their L2 was, presumably, every bit as strong as the L2 of group E2. Thus, it seems that the L1 was the principal basis of transfer for groups E1, P and S. For group E2, it appears that the more typologically similar L2 was the basis of transfer initially (before instruction in Portuguese pronunciation), but transfer from this language was reduced later on, in favor of positive transfer from the L1 and/or target L3 production.

Evidence was also found to support Muller and Muller's (1968) prediction that the more difficult GPCR to acquire would be the one which differed from the L1 and L2 (i.e., the <s>-[ʒ] rule, in this case). In general, participants produced <ʒ> items correctly more often than <s>

items, perhaps due in part to the possibility of positive transfer from English in the case of <z>, but not <s> (except in the case of those cognate <s> items where English would have [z]).

A negative relationship was also found between participants' production in the Spanish reading task and in the Portuguese reading tasks: the greater the accuracy in the Spanish reading task was, the lower the accuracy in Portuguese tended to be. This inverse relationship supports observations and studies in the literature reviewed above, which found persistent difficulties for Spanish speakers learning Portuguese pronunciation.

Finally, the section on variation showed some of the other sounds which participants produced, and displayed some of the disparity found in the production of different words. All of the words showed evidence of negative transfer: a cognate <z> item, *horizonte* ("horizon"), suffered the least negative transfer (on only 14% of its production), while a cognate <s> item where both English and Spanish would have [s], *generosidade* ("generosity"), suffered the most negative transfer (on 99% of its production). It is interesting that these two ends of the spectrum, in terms of transfer (negative and possibly positive, too), should be found on cognate words. The discussion of the effect of word type on production, and the question regarding participants' ability to generalize the pronunciation rules from seen to unseen words, is taken up in more detail in the next chapter.

Table 4-1. Number and percentage of <s> items, by production type and test

Type	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %
EN	21	1	34	2	24	2
EP	113	7	148	10	146	10
ES	860	57	780	52	741	49
NO	7	0	6	0	6	0
OTH	16	1	10	1	11	1
PO	144	10	251	17	305	20
SP	347	23	279	19	275	18

Table 4-2. ANOVA for all production types for <s>

Effect	Num DF	F Value	P Value
test	2	0.00	1.0000
group	3	0.00	1.0000
production type	6	697.13	*<.0001
test*production type	12	9.12	*<.0001
group*production type	18	13.25	*<.0001
group*test	6	0.00	1.0000
group*test*production type	36	0.74	0.8681

Table 4-3. Post-hoc t-test results for all production types for <s> on Test 1

Type	EN	EP	ES	NO	OTH	PO	SP
EN		*0.0187	*<.0001	1.0000	1.0000	*<.0001	*<.0001
EP			*<.0001	*0.0033	*0.0147	0.8903	+*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							*<.0001
SP							

Table 4-4. Post-hoc t-test results for all production types for <s> on Test 2

Type	EN	EP	ES	NO	OTH	PO	SP
EN		*0.0003	*<.0001	1.0000	1.0000	*<.0001	*<.0001
EP			*<.0001	*<.0001	*<.0001	*<.0001	+*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							0.9473
SP							

Table 4-5. Post-hoc t-test results for all production types for <s> on Test 3

Type	EN	EP	ES	NO	OTH	PO	SP
EN		*<.0001	*<.0001	1.0000	1.0000	*<.0001	*<.0001
EP			*<.0001	*<.0001	*<.0001	*<.0001	+*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							1.0000
SP							

Table 4-6. Number and percentage of <s> items, by production type and participant group

	EN	EN	EP	EP	ES	ES	NO	NO	OTH	OTH	PO	PO	SP	SP
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
E1	53	2	242	10	1267	54	15	1	26	1	333	14	413	18
E2	0	0	31	7	228	52	1	0	3	1	52	12	120	28
P	23	3	94	12	361	46	2	0	4	1	207	26	92	12
S	3	0	40	4	525	55	1	0	4	0	108	11	276	29

Table 4-7. Post-hoc t-test results for production type EP for <s> items, by participant group

Group	E1	E2	P	S
E1		0.9992	1.0000	*0.0137
E2			0.9517	1.0000
P				*0.0104
S				

Table 4-8. Post-hoc t-test results for production type ES for <s> items, by participant group

Group	E1	E2	P	S
E1		1.0000	*0.0005	1.0000
E2			0.5945	1.0000
P				*0.0013
S				

Table 4-9. Post-hoc t-test results for production type PO for <s> items, by participant group

Group	E1	E2	P	S
E1		1.0000	*<.0001	0.9813
E2			*<.0001	1.0000
P				*<.0001
S				

Table 4-10. Post-hoc t-test results for production type SP for <s> items, by participant group

Group	E1	E2	P	S
E1		*0.0004	0.0713	*<.0001
E2			*<.0001	1.0000
P				*<.0001
S				

Table 4-11. Post-hoc t-test results for all production types for <s> items for participant group E1

Type	EN	EP	ES	NO	OTH	PO	SP
EN		*<.0001	*<.0001	0.9999	1.0000	<.0001	*<.0001
EP			*<.0001	*<.0001	*<.0001	0.1370	+*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							0.3669
SP							

Table 4-12. Post-hoc t-test results for all production types for <s> items for participant group E2

Type	EN	EP	ES	NO	OTH	PO	SP
EN		0.6029	*<.0001	1.0000	1.0000	*0.0024	+*<.0001
EP			*<.0001	0.6724	0.7977	0.9913	*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*0.0034	*<.0001
OTH						*0.0071	*<.0001
PO							*<.0001
SP							

Table 4-13. Post-hoc t-test results for all production types for <s> items for participant group P

Type	EN	EP	ES	NO	OTH	PO	SP
EN		*0.0016	*<.0001	0.9999	1.0000	*<.0001	*0.0029
EP			*<.0001	*<.0001	*<.0001	*<.0001	+1.0000
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							*<.0001
SP							

Table 4-14. Post-hoc t-test results for all production types for <s> items for participant group S

Type	EN	EP	ES	NO	OTH	PO	SP
EN		0.9289	*<.0001	1.0000	1.0000	*<.0001	*<.0001
EP			*<.0001	0.8812	0.9469	*0.0206	+*<.0001
ES				*<.0001	*<.0001	+*<.0001	*<.0001
NO					1.0000	*<.0001	*<.0001
OTH						*<.0001	*<.0001
PO							*<.0001
SP							

Table 4-15. Number and percentage of <z> items, by production type and test

Type	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %
EP	588	60	719	73	793	80
NO	13	1	17	2	8	1
OTH	17	2	21	2	24	2
SP	370	37	231	23	163	16

Table 4-16. ANOVA for all production types for <z>

Effect	Num DF	F Value	P value
test	2	0.00	1.0000
group	3	0.00	1.0000
production type	3	405.24	*<.0001
test*production type	6	18.33	*<.0001
group*production type	9	46.20	*<.0001
group*test	6	0.00	1.0000
group*test*production type	18	1.83	*0.0196

Table 4-17. Post-hoc t-test results for all production types for <z> on Test 1

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+ 0.9280
NO			1.0000	*<.0001
OTH				*<.0001
SP				

Table 4-18. Post-hoc t-test results for all production types for <z> on Test 2

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+ *<.0001
NO			1.0000	*<.0001
OTH				*<.0001
SP				

Table 4-19. Post-hoc t-test results for all production types for <z> on Test 3

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+ *<.0001
NO			1.0000	*0.0003
OTH				*0.0014
SP				

Table 4-20. Number and percentage of <z> items, by production type and participant group

	EP #	EP %	NO #	NO %	OTH #	OTH %	SP #	SP %
E1	1261	82	25	2	40	3	213	14
E2	176	62	4	1	3	1	102	36
P	426	83	3	1	10	2	74	14
S	237	38	6	1	9	1	375	60

Table 4-21. Post-hoc t-test results for production type EP for <z> items, by participant group

Type	E1	E2	P	S
E1		*0.0009	1.0000	*<.0001
E2			*0.0042	*0.0002
P				*<.0001
S				

Table 4-22. Post-hoc t-test results for production type SP for <z> items, by participant group

Type	E1	E2	P	S
E1		*0.0002	1.0000	*<.0001
E2			*0.0039	*0.0002
P				*<.0001
S				

Table 4-23. Post-hoc t-test results for all production types for <z> items for participant group E1

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+*<.0001
NO			1.0000	*0.0002
OTH				*0.0010
SP				

Table 4-24. Post-hoc t-test results for all production types for <z> items for participant group E2

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+*0.0011
NO			1.0000	*<.0001
OTH				*<.0001
SP				

Table 4-25. Post-hoc t-test results for all production types for <z> items for participant group P

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+*<.0001
NO			1.0000	0.1070
OTH				0.2339
SP				

Table 4-26. Post-hoc t-test results for all production types for <z> items for participant group S

Type	EP	NO	OTH	SP
EP		*<.0001	*<.0001	+*<.0001
NO			1.0000	*<.0001
OTH				*<.0001
SP				

Table 4-27. Number and percentage of <z> items, by production type, participant group and test

	EP #	EP %	SP #	SP %
E1	380 (T 1)	74 (T 1)	115 (T 1)	22 (T 1)
	432 (T 2)	84 (T 2)	52 (T 2)	10 (T 2)
	449 (T 3)	88 (T 3)	46 (T 3)	9 (T 3)
E2	31 (T 1)	33 (T 1)	59 (T 1)	62 (T 1)
	62 (T 2)	65 (T 2)	32 (T 2)	34 (T 2)
	83 (T 3)	87 (T 3)	11 (T 3)	12 (T 3)
P	131 (T 1)	77 (T 1)	37 (T 1)	22 (T 1)
	142 (T 2)	83 (T 2)	25 (T 2)	15 (T 2)
	153 (T 3)	89 (T 3)	12 (T 3)	7 (T 3)
S	46 (T 1)	22 (T 1)	159 (T 1)	76 (T 1)
	83 (T 2)	40 (T 2)	122 (T 2)	58 (T 2)
	108 (T 3)	52 (T 3)	94 (T 3)	45 (T 3)

Table 4-28. Post-hoc t-test results for production type EP for <z> items, by participant group and test

Type	E1	E2	P	S
E1		*0.0002 (T 1)	1.0000 (T 1)	*<.0001 (T 1)
		0.9530 (T 2)	1.0000 (T 2)	*<.0001 (T 2)
		1.0000 (T 3)	1.0000 (T 3)	*<.0001 (T 3)
E2			0.0011 (T 1)	1.0000 (T 1)
			0.9986 (T 2)	0.6390 (T 2)
			1.0000 (T 3)	*0.0298 (T 3)
P				*<.0001 (T 1)
				*<.0001 (T 2)
				*0.0002 (T 3)
S				

Table 4-29. Post-hoc t-test results for production type SP for <z> items, by participant group and test

Type	E1	E2	P	S
E1		*0.0005 (T 1)	1.0000 (T 1)	*<.0001 (T 1)
		0.5856 (T 2)	1.0000 (T 2)	*<.0001 (T 2)
		1.0000 (T 3)	1.0000 (T 3)	*<.0001 (T 3)
E2			*0.0061 (T 1)	1.0000 (T 1)
			0.9944 (T 2)	0.7211 (T 2)
			1.0000 (T 3)	0.0752 (T 3)
P				*<.0001 (T 1)
				*<.0001 (T 2)
				*0.0002 (T 3)
S				

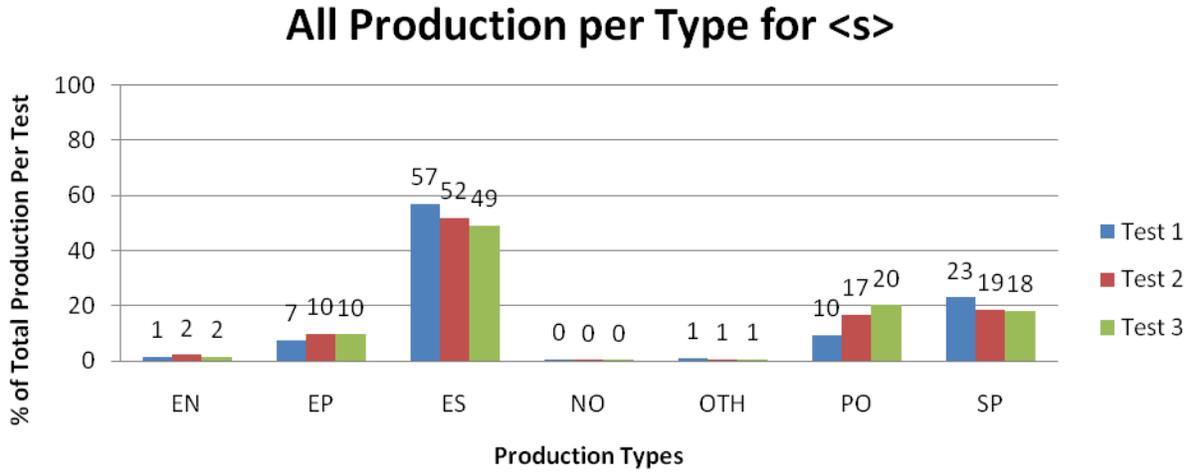


Figure 4-1. Percentage of <s> items, by test for each production type

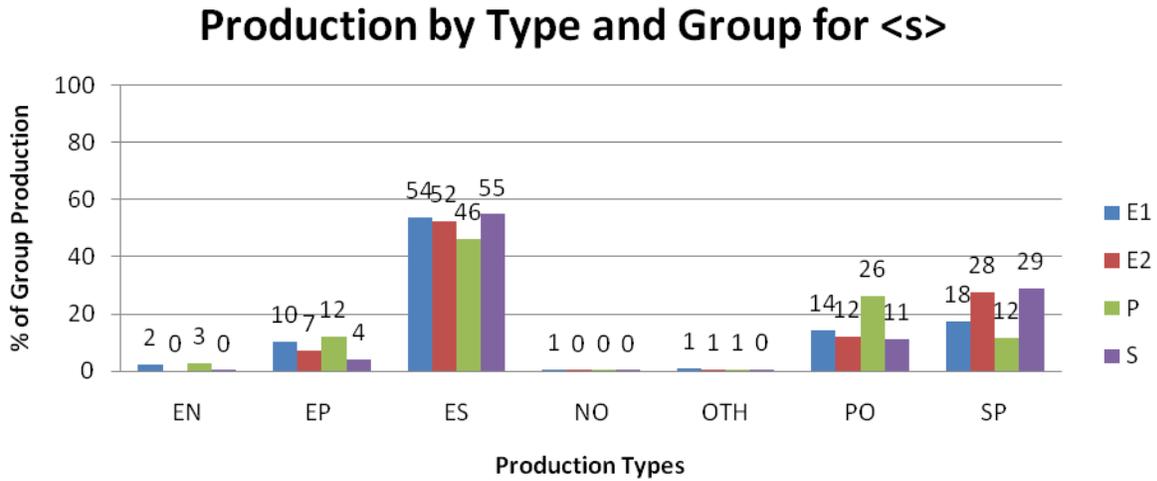


Figure 4-2. Percentage of <s> items, by participant group for each production type

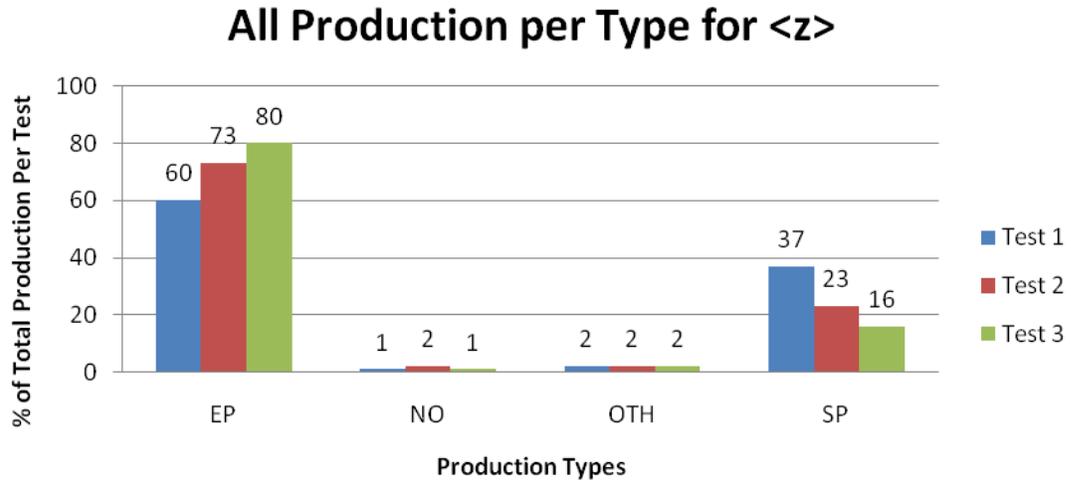


Figure 4-3. Percentage of <z> items, by test for each production type

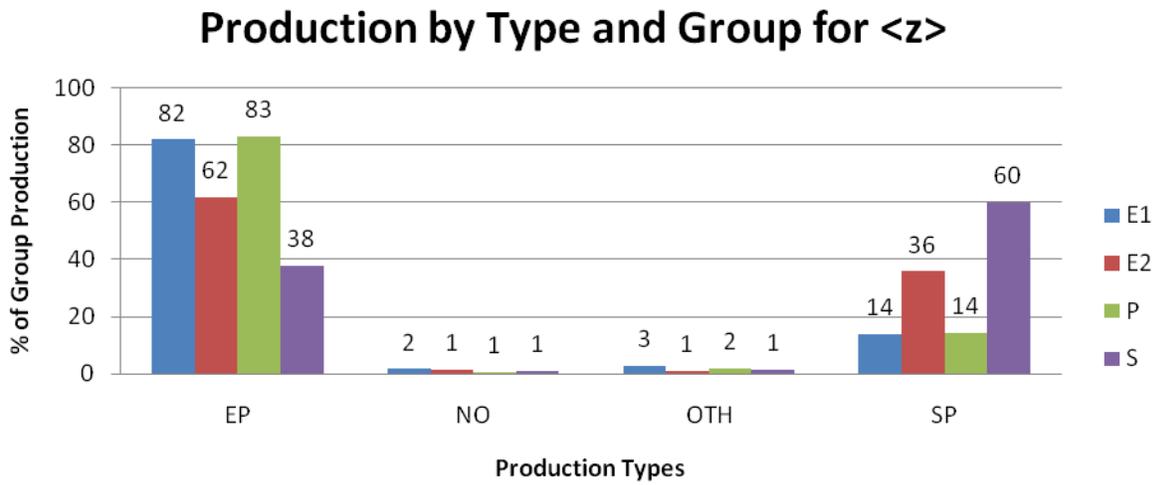


Figure 4-4. Percentage of <z> items, by participant group for each production type

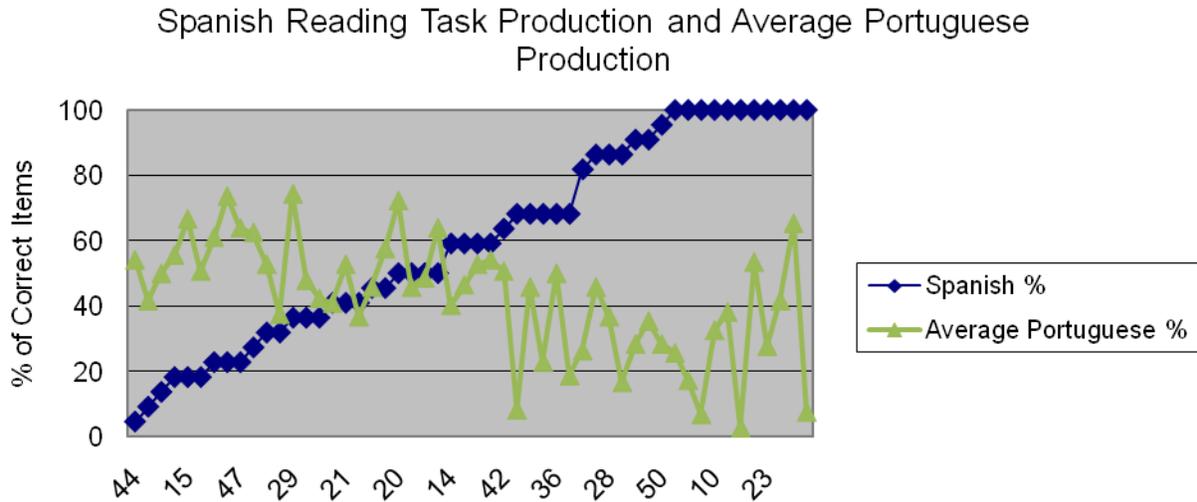


Figure 4-5. Percentage of correct items on Spanish reading task and average percentage of correct items on Portuguese reading tasks

Participant numbers are shown on the horizontal axis, ordered according to accuracy of production on the Spanish reading task. For the sake of readability, only some of the participant numbers are shown (one in four).

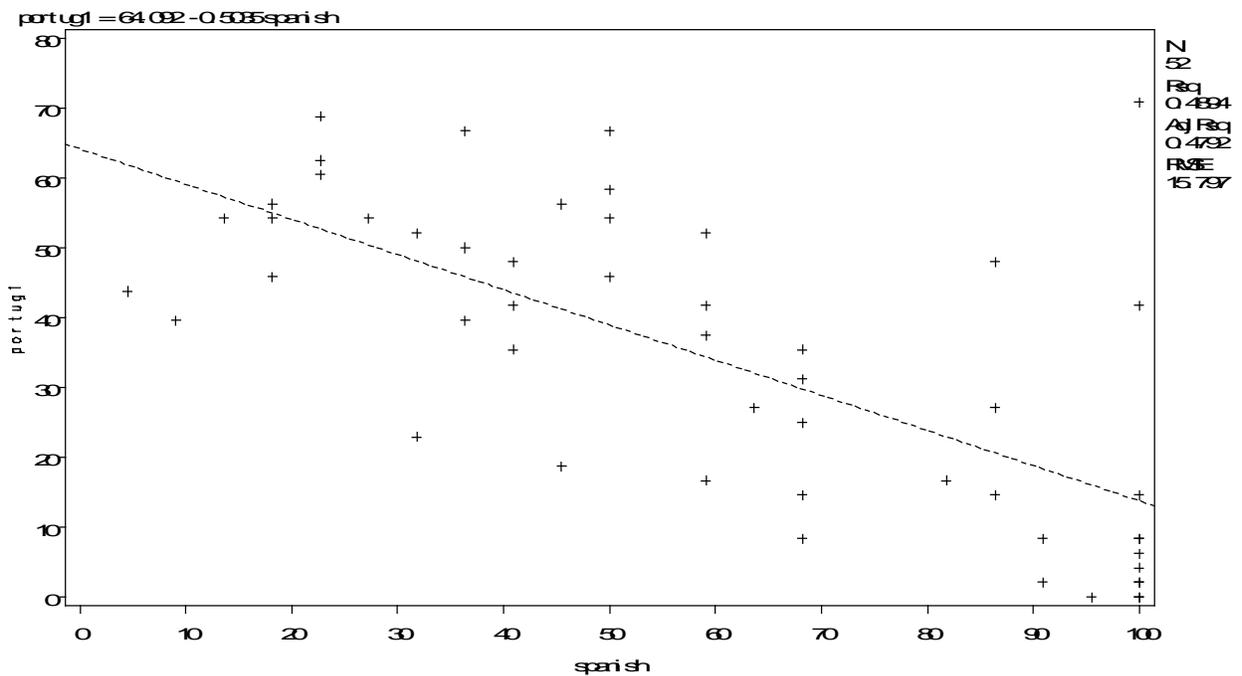


Figure 4-6. Relationship between production on Spanish reading task and average production on Portuguese reading tasks

CHAPTER 5 GENERALIZABILITY – RESULTS AND DISCUSSION

5.1 Introduction

This chapter addresses the third broad research question, regarding generalizability, by presenting and discussing the relevant results. Before considering these, it is useful to recall the research questions asked and hypotheses stated (in section 2.2.3) concerning generalizability. The term generalizability was used to refer to participants' ability to apply the GPCRs that they had learned for seen words to unseen words. The principal question was what differences in production might arise due to word type: cognates, non-cognates and nonce-words. In light of Defior et al.'s (2002) and Lord's (2007) findings that real words were read faster and more accurately than nonce words, it was postulated that the orthographic-phonological correspondences in seen words (cognates and non-cognates) would be produced more accurately than those in unseen words (nonce words), due to learners' greater familiarity with and exposure to the former. The results will be presented and discussed first for all production, then production by grapheme. Next, production of the cognate <s> items will be examined separately, in view of the three sounds that occur for the English equivalents of these items. Variation between groups and individuals will then be discussed, with a general summary of results to follow.

5.2 Results and Discussion

Results are presented in terms of raw production scores, proportions of correct items out of all possible items per word type, and statistically significant differences (output from the model), which are marked with an asterisk in the tables.

5.2.1 Production for Graphemes <s> and <z>

Considering together the production of all the participants, irrespective of group and grapheme, the data showed correct production of [z] on 1437 (out of 3588) cognate items, 842

(out of 1872) nonce items, and 928 (out of 2028) non-cognate items. Expressed as percentages of possible correct items, these raw scores are equivalent to 40%, 45% and 46%, respectively (Table 5-1). When all production (both graphemes and all three tests) was considered, correct production appeared to be roughly the same across all three word types (Figure 5-1).

The ANOVA (refer back to Table 3-7) showed that the interaction between grapheme and word type was significant. Other interactions which were shown to be significant by the ANOVA did not involve word type, which is of principal concern in this chapter, so only the significant interaction with word type is discussed here. Other significant interactions have been discussed in previous chapters. Since the ANOVA results showed the grapheme by word type interaction to be significant, it is necessary to consider the graphemes separately.

5.2.2 Production by Grapheme

Correct production was summed (raw scores) for each word type, by grapheme, and then calculated as a percentage of all possible production for that word type and grapheme (Table 5-2). The percentage of correct tokens is also shown graphically for each word type and grapheme (Figure 5-2). Post-hoc Tukey t-tests were carried out to determine statistically significant differences between graphemes for each word type, and between word types for each grapheme. Results of the t-tests revealed significant differences between <s> and <z> on all three word types, with <z> produced correctly significantly more often than <s> (Table 5-3). This result suggests that accuracy in production has less to do with word type and more to do with orthography, an observation that appears to be confirmed by the fact that no significant differences were found between word types for <z> items (Table 5-4).

Since participants produced <z> items with relatively the same accuracy across all word types, it would appear that there were no facilitatory or inhibitory effects for <z> cognates as compared with <z> words which were not cognates (i.e., non-cognates and nonce words).

Additionally, the lack of significant differences observed between seen words (cognates and non-cognates) and unseen words (nonce words) does not permit any conclusion to be drawn concerning whether production is lexically driven or rule driven.

In the case of <s> tokens, however, there appeared to be a facilitatory effect for cognates compared with non-cognates and nonce words (Table 5-5). Cognate <s> items were accurately produced significantly more often than non-cognate <s> and nonce <s> items. As with <z>, though, no significant difference was observed between non-cognate and nonce <s> items, which again makes it impossible to draw any conclusion about learners' ability to generalize from seen to unseen words. The ostensibly facilitatory effect found for <s> cognates bears further investigation, considering that this group of tokens included words which would have different sounds in English for <s>.

5.2.3 Cognate <s> Items

The group of cognate <s> items had an unusual characteristic: one orthographic-phonological correspondence rule in Portuguese (<s>-[z]), and one rule, albeit a different one, in Spanish (<s>-[s]), but three rules in English: five words pronounced with [z], six words pronounced with [s], and six words pronounced with [ʒ] (Table 5-6). This group of <s> items allows a more in-depth exploration of orthographic-phonological correspondences. Till now, this dissertation has examined only differences between graphemes (<z> and <s>), and between word types (cognate, non-cognate and nonce); now, the consideration is of items within a single word type with one grapheme. What makes this analysis interesting is that the three sets of English sounds for these cognates fall into different production categories with respect to the two other languages under consideration, namely Portuguese and Spanish. That is, those words where English would have [z] share a correspondence rule with Portuguese but not with Spanish; those words where English would have [s] share a correspondence rule with Spanish but not with

Portuguese; and those words where English would have [ʒ] do not share a correspondence rule with either Portuguese or Spanish. Thus, it would seem plausible to infer that the English correspondence rules play a part where differences are observed between the three sets of cognate <s> tokens.

Correct production for these three sets of <s> words (where the set name is the sound in English) was summed (raw scores) and then calculated as a percentage of possible items (Table 5-7). Results are shown graphically for the three sets of <s> cognates for each test (Figure 5-3). Numerically, scores tend to increase between tests, for the three sound groups. Tokens with [z] in English are seen to be produced correctly more often than tokens with [ʒ] in English, which in turn are observed to be produced accurately more regularly than tokens with [s] in English.

The ANOVA (Table 5-8) shows that each of the individual factors – group, test and English sound – is significant, as is the interaction between group and sound; thus it is necessary to examine the production of cognate <s> words according to the four participant groups. Correct production for the four language groups was summed (raw scores) and then calculated as a percentage of possible production (Table 5-9). Results are shown graphically by participant group for each of the three sets of cognate <s> items (Figure 5-4). A number of statistically significant differences were found, both between and within participant groups.

For cognate <s> tokens where English would have [z] in the pronunciation (Table 5-10), groups E1 and P produced <s> correctly as [z] (according to the target Portuguese rules) significantly more often than group S. There were no significant differences between L1 English speakers with low or no Spanish (E1 and P, mostly) and the L1 English speakers proficient in Spanish (E2), nor was there a significant difference between the L1 English speakers proficient in Spanish (E2) and the native Spanish speakers (S). In other words, for this set of items, group

E2 fell in the middle (between groups E1 and P at the higher end, and group S at the lower end) with production that proved not to be significantly different from any other group. When it came to the cognate <s> tokens where English would have [s] (Table 5-11), no significant differences were found between groups. That is, L1 English speakers, irrespective of proficiency in Spanish, L1 Spanish speakers, and those with previous exposure to Portuguese all produced these tokens with relatively the same (low) degree of accuracy. For those cognate <s> items where English would have [ʒ] (Table 5-12), there were only significant differences between groups P and E2, and between P and S. In both comparisons, group P participants produced the items with greater accuracy. For this set of words, group E1 fell in the middle (between group P at the higher end, and groups E2 and S at the lower end) with production that proved not to differ significantly from any other group.

Considering each group separately, it can be seen that E1 production differed significantly for the three sets of cognate <s> tokens (Table 5-13), as did production by group P (Table 5-14). For both groups, those tokens where English would have [z] were produced accurately most often, followed by those tokens where English would have [ʒ], followed by those tokens where English would have [s]. For group E2 (Table 5-15), those tokens where English would have [z] were produced accurately significantly more often than the other tokens, but no significant differences were found between the other two sets of tokens (where English would have [s] or [ʒ]). Finally, group S showed no significant differences between any of the three sets of cognate <s> tokens (Table 5-16).

The results for these three sets of cognate <s> tokens are noteworthy. It bears repeating that all of these words are cognates containing the grapheme <s>, but that is clearly not a sufficient description. Since the orthographic-phonological correspondence rules for these words

remain constant in Portuguese (<s>-[z]) and in Spanish (<s>-[s]), it seems fair to state that the differences which were observed between the three sets of words arose as a result of the different English correspondence rules for the three sets. As seen in previous chapters, here again it was observed that linguistic background played a part in production. For the native Spanish speakers (group S), who had a consistent correspondence rule in their L1, there were no statistical differences observed across the three sets of cognate <s> words. For the native English speakers (groups E1, E2 and most of P), who had different correspondence rules in their L1, there were statistical differences in production between the sets. For all of the L1 English speakers, accurate production, according to the target Portuguese rule, was significantly greater when the L1 correspondence rule coincided with the target rule (<s>-[z]).

When the L1 and L2 rules coincided with each other (<s>-[s]) but differed from the L3 Portuguese rule (<s>-[z]), no differences were observed between groups, corroborating what has been discussed in previous chapters: when two similar rules in a learner's previous languages coincide, there is greater inaccuracy in production according to a different rule in the new language (L3). When the three languages had different correspondence rules, it appeared that differences in production were due primarily to previous instruction in the new language (group P significantly outperformed groups E2 and S), rather than due to the L1 (groups E1 and E2 did not differ significantly from each other), or due to proficiency in Spanish (groups E2 and S did not differ significantly from each other). Consideration will now be given to some of the variation found for particular words and word categories.

5.3 Other Observations

Here, production of individual words is discussed. The percentages of correct production by word (Appendix M) relate to overall production, that is, by all participants on all tests.⁴⁸ It is interesting to observe tendencies within groups of words. For cognate <s> words where English would have [z], accuracy ranged from 46% for *visível* (“visible”) to 68% for *presidente* (“president”). For cognate <s> words where English would have [s], accuracy ranged from 1% for *generosidade* (“generosity”) to 27% for *casos* (“cases”). For cognate words where English would have [ʒ], accuracy ranged from 13% for *divisões* (“divisions”) to 48% for *visão* (“vision”). For nonce <s> words, accuracy ranged from 11% for *lomosa* to 24% for *iságio*; while for non-cognate <s> words, accuracy ranged from 6% for *manhoso* (“whiney”) to 29% for *casaco* (“coat”). For cognate <z> words, accuracy ranged from 62% for *idealização* (“idealization”) to 86% for *horizonte* (“horizon”). For nonce <z> words, accuracy ranged from 53% for *paimozes* to 83% for *trazentar*. Finally, for non-cognate <z> words, accuracy ranged from 55% for *rapazes* (“young men”) to 79% for *azedo* (“sour”).

Clearly, there was a great deal of variation between the high and low points of the ranges, yet the distance between these points was relatively similar across the different word types and graphemes. These tendencies are interesting to consider as they illustrate the variability that occurs, in terms of accurate production, within a single word category for a single grapheme. Why there is such variability is difficult to pinpoint, but possible reasons may include how often the participants were exposed to the words in class (for seen words), word length, closeness in

⁴⁸ Although certain differences in production were found between groups in the previous section, here production by all participants is considered together, for the sake of brevity and clarity, since the purpose of this section is merely to present some of the salient and interesting differences between words.

form to known words, or a combination of such factors. While the effect of these things was not controlled for or looked at in this study, future studies addressing these issues may be beneficial.

It is noteworthy that the most accurately produced word was the cognate <z> word *horizonte* (“horizon”), where English would have [z], and the least accurately produced word was the cognate <s> word *generosidade* (“generosity”), where English and Spanish would have [s]. With the former being produced correctly on 86% of instances, and the latter being produced correctly on only 1% of instances, there is clearly still room for improvement on all items, which is to be expected for learners in the early stages of language acquisition. What seems almost incomprehensible is that the least accurately produced word, *generosidade* (“generosity”) was produced correctly by only one participant on one test (that is, once out of a possible 156 times). This level of inaccuracy is difficult to explain, though it might be due to a combination of the aforementioned factors: it is a relatively long word (six syllables), its use in the classroom may have been relatively low, and its closeness to known words (*generous*, *generosity* in English, for example) is high. Additionally, it falls into the category of words where the L1 and L2 share a correspondence rule which differs from the rule in the target L3, a case which is potentially subject to negative transfer from both of a learner’s previous languages. These observations about particular words and groups of words reinforce yet again the effect of the grapheme on accurate production, as well as the role of the learners’ previous languages in the acquisition of orthographic-phonological correspondence rules in L3.

5.4 Summary

In this chapter, word type (cognate, non-cognate, or nonce) was considered as a factor which might affect production. Output from the statistical model showed a significant interaction between word type and grapheme, revealing that accurate production of grapheme <z> items occurred significantly more than accurate production of grapheme <s> items, across all word

types. Differences between word types were not found to be statistically significant for <z>, and <s> only showed statistically significant differences between cognates and other words (non-cognates and nonce). Thus, evidence was not found to support the hypothesis that participants would do better on seen words than unseen words, based on the findings from the study by Defior et al. (2002) and Lord (2007) where real words were read faster and more accurately than nonce words.

A closer examination of the cognate <s> words, which contained three sets of tokens, according to different grapheme-phoneme correspondence rules in English, revealed an interaction between participant groups and sets of cognate <s> words with different sounds in English ([z], [s] and [ʒ]). It was found that accuracy of production of these sets of cognate <s> words varied, depending largely on the L1 of the participants. Native Spanish speakers (group S), whose L1 correspondence rule would have been the same for all three sets of cognate <s> tokens (<s>-[s]), showed no significant differences in production across the three sets. L1 English speakers (groups E1, E2 and most of P) displayed greater accuracy on words where English would have [z], similar to the target Portuguese rule. When the L1 and L2 correspondence rules coincided (<s>-[s]), differing from the target L3 rule (<s>-[z]), no significant differences were found between groups.

All of these results appear to indicate that word type did not play as important a part in production in this study as the factors discussed in previous chapters. Nevertheless, the closer examination of the cognate <s> tokens with different English correspondence rules was revealing, as it shed light on the crucial role that the L1's system of correspondence rules played in L3 production. This analysis of the three sets of cognate <s> items is useful because it may help to clarify the origin of transfer (English or Spanish) for non-cognate and nonce <s> items,

where the rules for English and Spanish pronunciation would coincide (<s>-[z]). For the results discussed in previous chapters, it wasn't possible to tease apart whether incorrect production of [s] for grapheme <s> items was suggestive of negative transfer from English or from Spanish. Now, however, it would appear that the groups of native English speakers (E1, E2 and most of P) were producing sounds according to the rules of their L1, given that there were significant differences between the sets of <s> cognates for these groups; while the native Spanish speakers (S) were producing sounds according to the rules of their L1, since there were no significant differences between the <s> cognate sets for this group. Thus, it seems plausible to propose that the groups producing [s] on the non-cognate and nonce <s> items would also be transferring largely from their L1. This suggestion bears further investigation, something which will be addressed further in the next chapter's concluding remarks.

Table 5-1. Number and percentage of correct items for all [z], by word type

Word Type	Raw Scores	Possible	Percentages
Cognate	1437	3588	40
Nonce	842	1872	45
Non-cognate	928	2028	46

Table 5-2. Number and percentage of correct items, by grapheme and word type

Word Type by Grapheme	Raw Scores	Possible	Percentages
Cognate <s>	777	2652	29
Nonce <s>	166	936	18
Non-cognate <s>	164	936	18
Cognate <z>	660	936	85
Nonce <z>	676	936	72
Non-cognate <z>	764	1092	82

Table 5-3. Post-hoc t-test results comparing graphemes for each word type

	<s> compared to <z>
Cognate	*<.0001
Nonce	*<.0001
Non-cognate	*<.0001

Table 5-4. Post-hoc t-test results comparing word types for <z>

<z>	Cognate	Nonce	Non-cognate
Cognate		0.9618	0.9998
Nonce			0.8824
Non-cognate			

Table 5-5. Post-hoc t-test results comparing word types for <s>

<s>	Cognate	Nonce	Non-cognate
Cognate		*<.0001	*<.0001
Nonce			1.0000
Non-cognate			

Table 5-6. Cognate <s> words, with corresponding sound in English

Cognate <s> Word	English
<i>apresentação</i> (“presentation”)	[z]
<i>esquisito</i> (“odd”)	[z]
<i>museu</i> (“museum”)	[z]
<i>presidente</i> (“president”)	[z]
<i>visível</i> (“visible”)	[z]
<i>básico</i> (“basic”)	[s]
<i>casos</i> (“cases”)	[s]
<i>curiosidade</i> (“curiosity”)	[s]
<i>filosofia</i> (“philosophy”)	[s]
<i>generosidade</i> (“generosity”)	[s]
<i>persuasivo</i> (“persuasive”)	[s]
<i>audiovisual</i> (“audiovisual”)	[ʒ]
<i>decisão</i> (“decision”)	[ʒ]
<i>divisões</i> (“division”)	[ʒ]
<i>revisão</i> (“revision”)	[ʒ]
<i>televisão</i> (“television”)	[ʒ]
<i>visão</i> (“vision”)	[ʒ]

Table 5-7. Number and percentage of correct items, by cognate <s> set

Cognate <s>	Test 1 #	Test 1 %	Test 2 #	Test 2 %	Test 3 #	Test 3 %	Total #	Total %
English [z]	113	43	148	57	146	56	407	52
English [s]	11	4	29	9	37	12	77	8
English [ʒ]	76	24	101	32	116	37	293	31

Table 5-8. ANOVA for cognate <s> items

Effect	Num DF	F Value	P Value
group	3	4.60	*0.0036
test	2	12.11	*<.0001
sound	2	102.92	*<.0001
group*test	6	0.65	0.6882
group*sound	6	12.53	*<.0001
test*sound	4	0.59	0.6704
group*test*sound	12	0.58	0.8600

Table 5-9. Number and percentage of correct items for <s> cognate sets, by participant group

	[z] #	[z] %	[s] #	[s] %	[ʒ] #	[ʒ] %
E1	242	60	26	5	160	33
E2	31	41	14	16	10	11
P	94	70	18	11	84	52
S	40	24	19	10	39	20

Table 5-10. Post-hoc t-test results for cognate <s> set with [z] in English, by participant group

<s>-English [z]	E1	E2	P	S
E1		0.7097	0.9733	*<.0001
E2			0.2561	0.8872
P				*<.0001
S				

Table 5-11. Post-hoc t-test results for cognate <s> set with [s] in English, by participant group

<s>-English [s]	E1	E2	P	S
E1		0.9948	0.9998	1.0000
E2	0.9948		1.0000	1.0000
P	0.9998	1.0000		1.0000
S	1.0000	1.0000	1.0000	

Table 5-12. Post-hoc t-test results for cognate <s> set with [ʒ] in English, by participant group

<s>-English [ʒ]	E1	E2	P	S
E1		0.4503	0.3014	0.7393
E2			*0.0086	0.9996
P				*0.0114
S				

Table 5-13. Post-hoc t-test results for cognate <s> sets for participant group E1

Group E1	[z]	[s]	[ʒ]
[z]		*<.0001	*<.0001
[s]			*<.0001
[ʒ]			

Table 5-14. Post-hoc t-test results for cognate <s> sets for participant group P

Group P	[z]	[s]	[ʒ]
[z]		*<.0001	*0.0425
[s]			*<.0001
[ʒ]			

Table 5-15. Post-hoc t-test results for cognate <s> sets for participant group E2

Group E2	[z]	[s]	[ʒ]
[z]		*0.0177	*0.0017
[s]			1.0000
[ʒ]			

Table 5-16. Post-hoc t-test results for cognate <s> sets for participant group S

Group S	[z]	[s]	[ʒ]
[z]		0.1003	0.9986
[s]			0.6242
[ʒ]			

All Production per Word Type

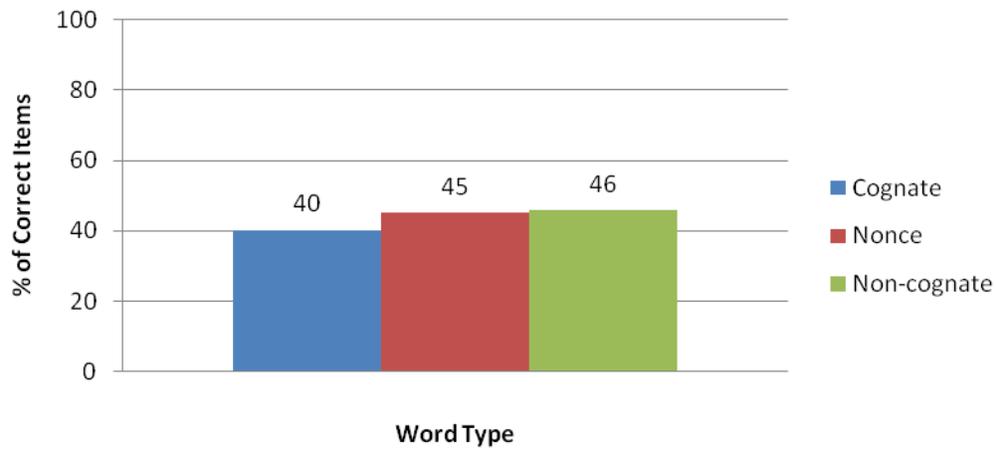


Figure 5-1. Percentage of correct items by word type

Production by Grapheme and Word Type

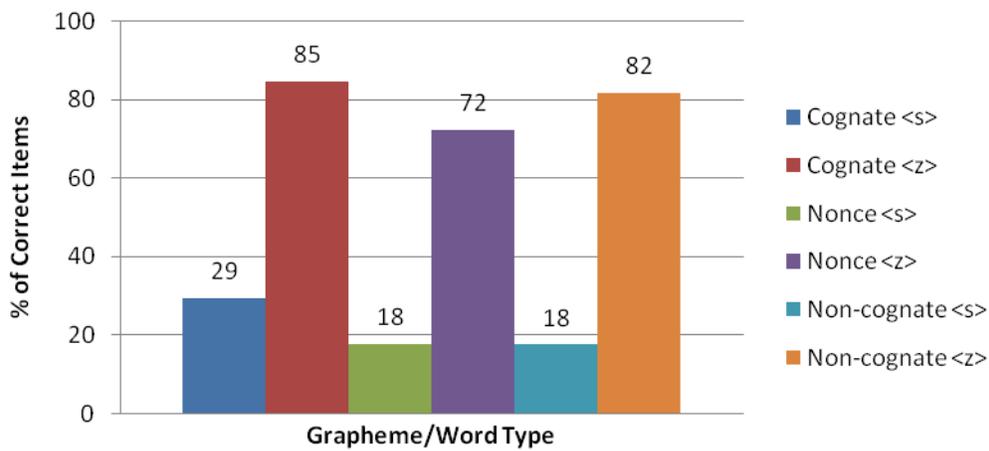


Figure 5-2. Percentage of correct items, by grapheme and word type

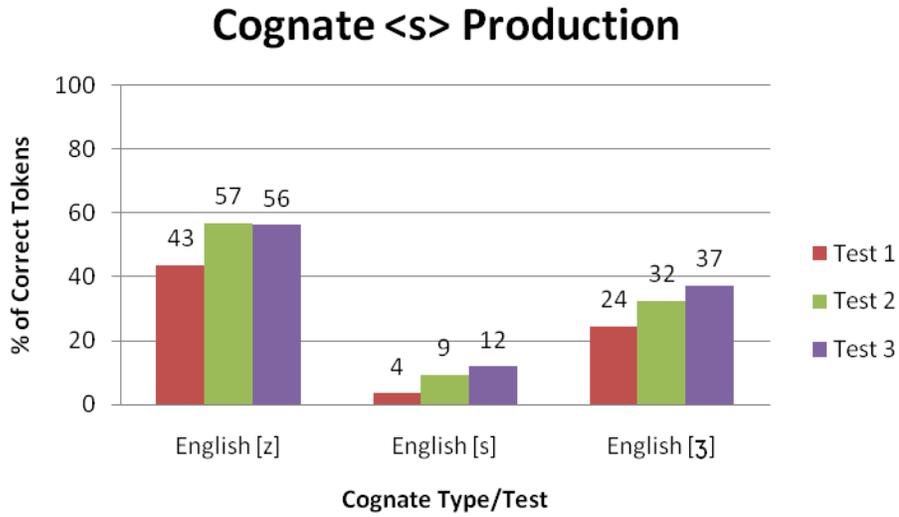


Figure 5-3. Percentage of correct items, by test for each cognate <s> set

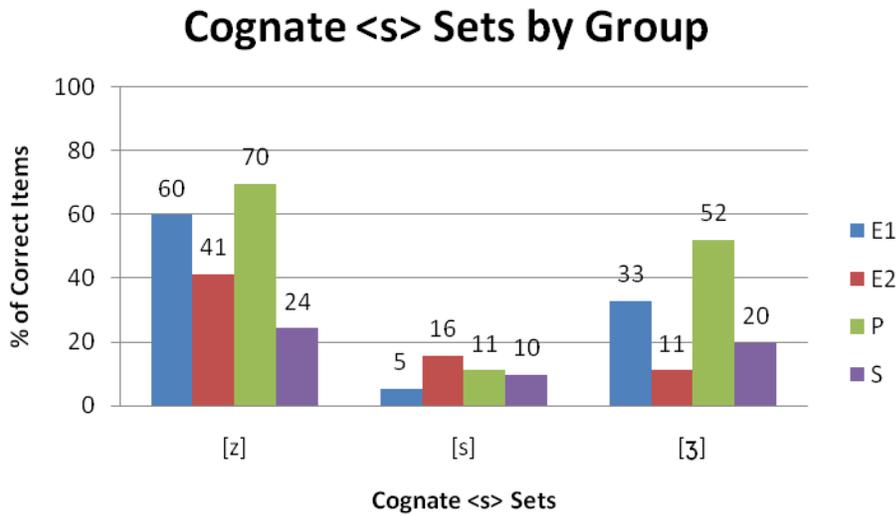


Figure 5-4. Percentage of correct items, by participant group for each cognate <s> set

CHAPTER 6 CONCLUSION

6.1 Introduction

The purpose of the current study was to investigate the acquisition of orthographic-phonological correspondence rules by learners of Portuguese as an L2 or L3, with L1 English and, where applicable, L2 Spanish, or L1 Spanish and L2 English. Acquisition was examined from the perspectives of error resolution, interference, and generalizability, in an effort to answer the study's overarching research questions regarding these three areas. In the next section, these questions and the initial hypotheses proposed (in section 2.2) are restated in summarized form, with the hypotheses confirmed or rejected, in light of the results found. Again, each of the questions is presented separately, for sake of clarity.

6.2 Acquisition of Orthographic-Phonological Rules

6.2.1 Error Resolution

R. Q. 1. To what extent do learners acquire the Portuguese grapheme-phoneme correspondence rules (GPCRs) under consideration, throughout the course of the semester?

H. 1. Significant increases in correct production were expected to occur throughout the semester of instruction, at least when all production data were considered together (both graphemes, all word types, all participant groups).

This hypothesis was confirmed, since significant progress was indeed found between tests, although for this group of learners as a whole, there was still much room for improvement at the end of the semester, in terms of accuracy in production.

R. Q. 2. What differences in acquisition exist between participant groups?

H. 2. It was hypothesized that there would be differences in correct production between the language groups, with lower accuracy being found in the production of the more proficient Spanish speakers.

This hypothesis was partially supported. Certainly the native Spanish speakers tended to produce the target Portuguese sounds less accurately than the native English speakers with low or no proficiency in Spanish. However, the native English speakers with high proficiency in Spanish tended to have less accuracy in Portuguese pronunciation only initially, and by the end of the semester their accuracy was not significantly different from that of any other group.

R. Q. 3. What differences in acquisition are there between the two graphemes <z> and intervocalic <s> corresponding to the phoneme /z/?

H.3. It was anticipated that there would be significant differences between tests for both graphemes, and significant differences between the two graphemes.

This hypothesis was partially confirmed. While there were no significant differences found between tests for each grapheme (the ANOVA result for the test by grapheme interaction was not found to be significant), a significant difference was found between the two graphemes, with <z> produced significantly more accurately than <s> by all participant groups.

6.2.2 Interference

R. Q. 1. What evidence is there of interference from the L1 and/or the L2?

H.1. It was anticipated that there would be evidence of interference from both the L1 and the L2, with these reducing over time. It was also hypothesized that there would be evidence in the data that participants were producing sounds which were neither consistent with the correspondence systems of the L1/L2 nor with that of the L3.

These hypotheses were confirmed. As a whole, participants tended to show evidence of transfer from the L1 and L2 (to varying degrees), with the influence of these reducing over time

as the role of the L3 increased in the learners' IL, evidenced by increased accuracy in target production. Additionally, participants produced sounds which were not consistent with the correspondence systems of the L1, L2 nor L3. Such production was almost always an approximation of a sound in one of the languages (e.g., a voiceless palatal fricative was produced where the English cognate would have the voiced palatal fricative), rather than a "rogue" sound, suggesting a universal tendency toward some unmarked feature (voicelessness, in the case of the example given).

R. Q. 2. What differences in interference are there between participant groups?

H. 2. It was hypothesized that the higher the proficiency level in the closely related language, Spanish, the more evidence of transfer there would be from that language in the target language production.

This hypothesis was supported to a certain extent. The proficient Spanish speakers (both native and non-native) showed significantly greater interference from Spanish than the native English speakers with low or no proficiency in Spanish, at least initially. By the end of the semester, the native English speakers with high proficiency in Spanish were not found to differ significantly from any other group. It is interesting to note that the native English speakers with low proficiency in Spanish also showed evidence of transfer from Spanish, their L2, although to a lesser extent than the participants proficient in Spanish. Additionally, it is worth mentioning that the native Spanish speakers, proficient in their L2, English, showed more evidence of transfer from the L1 (the more similar language to the target language) than the L2 (the less similar language). Thus, while it is evident that both language status (L1/L2) and language relatedness come into play in transfer, the results for the group of native Spanish speakers would suggest that language relatedness trumps language status.

R. Q. 3. What differences in interference exist between the two graphemes <z> and <s>?

H. 3. It was expected that there would be differences between the two graphemes, in light of the GPCRs in English, Portuguese and Spanish: it was anticipated that there would be greater accuracy in production of <z> due to the possibility of positive transfer from English, and less accuracy in production of <s> due to the possibility of only negative transfer from Spanish and generally negative transfer from English.

This hypothesis was supported, since participants as a whole produced <z> items correctly more often than <s> items, perhaps in part due to the possibility of positive transfer from English in the case of <z>, but not <s> (except in the case of those cognate <s> items where English would have [z]).

R. Q. 4. To what extent is production in Spanish related to acquisition (correct production) of Portuguese?

H. 4. It was anticipated that production in Spanish would be inversely related to acquisition of the Portuguese GPCRs in question. That is, it was expected that the greater the accuracy in Spanish production, the lower the accuracy in Portuguese production would tend to be.

Again, this hypothesis was confirmed, with a negative relationship being found between participants' production in the Spanish reading task and in the Portuguese reading tasks: students with higher accuracy in Spanish tended to have lower accuracy in Portuguese.

6.2.3 Generalizability

R. Q. 1 What differences in production arise due to word type (cognates, non-cognates and nonce-words)?

H. 1. It was predicted that the orthographic-phonological correspondences in seen words (cognates and non-cognates) would be produced more accurately than those in unseen words

(nonce words), due to learners' greater familiarity with and exposure to the former. That is, production would generally be lexically driven rather than rule driven.

This hypothesis was mostly rejected, since there were no significant differences between word types for grapheme <z>, and significant differences for grapheme <s> were only found between cognates and non-cognates, and between cognates and nonce words, with cognates produced more accurately than the other words. The results for grapheme <z> would seem to suggest that all production was rule driven, while the results for grapheme <s> would appear to indicate that there was a facilitatory effect for cognates, but this positive effect was found to be limited to the set of words where English would have the same correspondence rule as the target language, Portuguese (<s>-[z]), and was only found for native English speakers, suggesting that for grapheme <s> items, production is lexically driven, and more specifically, driven by the lexicon of the L1.

In summary, a general trend was found toward increased accuracy in production and decreased interference throughout the course of the semester of data collection. Some differences in production were observed between participant groups, graphemes, and word types. Proficient Spanish speakers, native and non-native, showed greater interference from Spanish than did non-proficient Spanish speakers, at least initially. This finding would suggest two things: 1) proficiency in a language has to be relatively high in order for it to be a significant source of transfer; and 2) structural relatedness (i.e., between Spanish and Portuguese here) appears to play a greater role in interference than language status (i.e., L1/L2), at least in the beginning. Significantly greater accuracy was found on grapheme <z> items than on grapheme <s> items, demonstrating that acquisition of pronunciation is closely related to orthography. Differences between word types were only found on <s> items, where cognates were produced more

accurately than other words. A closer examination of these cognate <s> items revealed that groups with L1 English were significantly more accurate on those items where their L1 had the same correspondence rule as the target L3 rule (<s>-[z]), while no such difference was found for L1 Spanish speakers.

The findings of the present study corroborate the complexity of a multilingual's linguistic system(s), as discussed previously in the literature. Both the L1 and the L2 play a role in the acquisition of an L3, to varying extents, depending on such factors as proficiency, language status, and language typology. The specific contributions and implications of the current study are considered further in the next section.

6.3 Contributions and Implications

This study makes a contribution in several areas, and has theoretical and applied implications. It contributes to the fields of L2 acquisition, L3 acquisition, and phonology, by specifically addressing the area of orthographic-phonological correspondence rules and systems, something which has not received considerable attention to date. This study also contributes to the existing literature on the acquisition of Portuguese, a less commonly taught and researched language.

6.3.1 Theoretical Implications

The results from the present study lend support to previous work done in several areas. Evidence was found to corroborate Muller and Muller's (1968) prediction that the more difficult correspondence rule to acquire in an L3 is that which has the same grapheme representing different phonemes in the L1/L2 and the L3. The findings here also support Major's (2001) OPM, showing an initial IL consisting of the L1 and L2, with these decreasing over time as the L3 increases, and with language universals (U) also playing a part in the IL.

Some of the conflicting results found in the literature – for instance, with regard to the effects of bilingualism on L3 acquisition, transfer from the L2 to the L3, the role of language status in transfer, the effects of a typologically similar language, etc. – are also reflected in this study's results. On the one hand, bilingualism at first seems to be disadvantageous for L1 English speakers proficient in Spanish, since they appear to transfer negatively from Spanish initially; but later production is at least as accurate as that of native English speakers not proficient in Spanish, suggesting that bilingualism may have positive effects (or maybe no effect) later on. On the other hand, bilingualism does not appear to be of much help to native Spanish speakers fluent in English, since their production seems to generally reflect negative transfer from their L1, even when positive transfer from the L2 would be possible.

As to whether proficiency in the L2 has to be low or high for it to be the basis of transfer in the L3, the present study shows greater influence from the L2 when proficiency is high, but only in the case of a more typologically similar language, since L1 Spanish speakers with high proficiency in L2 English tended not to transfer as much from their L2 as from their L1. Thus, the evidence found in this study indicates that language relatedness (similar vs. dissimilar) is more important than language status (L1 vs. L2), but only when proficiency in the related language is high. Given these findings, this study proposes that examination of orthographic-phonological correspondence rules, while uncommon, may perhaps be a clearer way to pinpoint more specifically the source of interference in an L3.

As for the role of different word types in the acquisition of grapheme-phoneme correspondence rules, this study did not generally support previous work which found facilitation or inhibition with cognates. Additionally it is hard to determine whether production here was lexically driven or rule driven, given that there was generally no difference between production

for seen words and for unseen words. The implication of these inconclusive results here is that additional research is required in this area, something which will be discussed in the section on future directions.

The findings of the current study not only support previous observations in the literature with regard to the persistent problem that Spanish speakers have in devoicing Portuguese intervocalic <s>, but also show that English speakers have the same problem. The fact that English has the same GPCR for intervocalic <s> as Spanish (in most cases) is not discussed in the literature, but is important to remember, in light of the fact that many Portuguese learners are also speakers of English, albeit not always as a native language. This point is discussed further in the next section, which considers some of the applied implications of the present study.

6.3.2 Applied Implications

This study further corroborates the complexity of orthographic-phonological correspondence systems, making salient the fact that acquisition of pronunciation in a new language involves more than simply learning new sounds, stress or intonation patterns; orthography also has a significant part to play in the acquisition of pronunciation. In order to assist learners in acquiring new or different orthographic-phonological correspondence rules, it may be helpful to have them participate in self-analysis projects, which would allow them to record, examine and monitor their own progress in acquisition (Lord, 2005).

It is also worth pointing out that, often, it is the contrasts between languages that are highlighted to learners, when maybe in this case explicit instruction regarding the similarities between a known language, English, and the target language, Portuguese, would be more advantageous to learners. For example, by illustrating to learners that English shares a rule for intervocalic <s> with Portuguese, and by providing specific examples of this, students may be

able to make helpful analogies in the L3, enabling them to extend that specific English rule for intervocalic <s> to all instances of intervocalic <s> in Portuguese.

The fact that the learners in this study did not appear to generalize the GPCRs to nonce words suggests that they are using lexical knowledge or stored exemplars to arrive at pronunciation, indicating that they may not have learned the rules for the realization of Portuguese grapheme-phoneme correspondences. Again, this highlights the need for explicit instruction regarding these rules and specific activities to practise their implementation, in order to assist in the acquisition of pronunciation.

While the findings of the present study have been inconclusive in certain respects, it has raised interesting questions regarding the acquisition of L3 orthographic-phonological correspondence rules, and the results firmly indicate how complex these rules and systems are, which must prompt further studies in this field, a point which will be taken up in the next section.

6.4 Limitations and Future Directions

Although the contributions are noteworthy, as with any study there are also several limitations to be addressed here. The method of participant selection resulted in a number of potential complications. Participants were selected from students enrolled in introductory Portuguese classes at the time of the study. While this form of participant selection was convenient, it made factors such as age, gender, and length of instruction in or exposure to previous languages impossible to control for, something which future studies might do well to take into account. Furthermore, it was difficult to find a good way to classify native English speakers according to their proficiency in Spanish. Grouping them according to the class in which they were enrolled (beginner or accelerated) seemed the most objective way to divide the participants, but some participants may have been assigned to one group when it might have been better to assign them to another group. The grouping criteria may have obfuscated some of

the results, and future studies might achieve different results if different criteria for grouping were used, say grouping according to some kind of pronunciation or proficiency test.

Additionally, having students participate in the study as they would in any normal class activity, without penalty or reward as far as their grade was concerned, may have resulted in some participants rushing through the activities, without giving due care and attention to the task.

Perhaps offering some form of incentive (grade or monetary) would address this limitation, though it may prove difficult to quantify the effect of an incentive (or lack thereof).

The materials and tasks developed are not without their limitations. In order to obtain data for the graphemes targeted by the present study, production was elicited rather than spontaneous. While elicited production may have its limitations (being contrived, it may not reflect what learners would do in natural speech), it would not have been possible for students in introductory classes of Portuguese to produce spontaneous data prior to instruction in the language, as was discussed in an earlier chapter. Thus, the materials and tasks were specifically developed for the present study in order to elicit production by all participants on the same words containing the particular GPCRs under investigation. In creating the materials, words found in the initial chapters of the textbook were used to ensure all participants had equal opportunities for exposure to them, with the additional inclusion of some words not found in the textbook in order to balance word categories as much as possible. Due to the limited number of words in the textbook containing the target grapheme, it was not possible to control for word length or frequency, nor for similarity or dissimilarity to words which participants might have known in their other language(s). Such factors might have affected the results (recall how the target grapheme in the longer word *idealização*, “idealization”, was often not produced), and it would be good if future studies could limit some of these differences.

In terms of the reading task itself, having participants move through the words (slides) at their own pace, rather than controlling the speed at which words were presented, may have resulted in some participants skipping over words inadvertently or on purpose in an effort to finish the activity more quickly. On the other hand, allowing participants to go at their own pace may have achieved two things: 1) it may have minimized the tedium for those participants who were fast readers and who would otherwise have spent a good deal of time waiting for words to appear automatically on the screen; and 2) it may have minimized anxiety for those participants who were not fast readers and who would otherwise not have had sufficient time to read words carefully. It would be interesting to have post-hoc feedback from participants as to whether they perceived this aspect of the study design to be positive or negative, something which another study might consider incorporating in order to inform future research.

As well as the method of data collection not being as controlled as possible, the equipment used was certainly not the most precise available, but realistically and logistically speaking, it was more accessible, easy to use, and inexpensive than experimental psycholinguistic equipment. Future work might consider using more precise equipment to record and analyze the data, rather than relying on rater judgments. Additionally, it would be interesting to consider response times along with accuracy in production. Response times might enable a difference to be seen in different word types, something which was not possible in the current study's examination of accuracy alone.

Another factor which was not controlled for in the present study was the effect of instruction. This clearly had an impact, although the extent to which instruction played a role is not known, nor what type of instruction was used or found more helpful (i.e., classroom vs. supplementary materials). Future studies can try to isolate this factor and see whether and how it

helps, by incorporating specific treatments (instruction), and by having a control group (with no explicit instruction).

As mentioned in the previous section, examining the acquisition of orthographic-phonological correspondence rules has real potential for pinpointing more precisely the source(s) of interference in an L3. Thus, it would be interesting to pursue this line of investigation with other correspondence rules and participants. It would be worth looking at graphemes or phonemes that would be new to participants with different linguistic backgrounds, such as the <ç>-[s] correspondence rule in Portuguese, which does not exist in English or Spanish. It might also be worthwhile to compare elicited (reading) and spontaneous (spoken) data from more advanced learners to establish the effect of written stimuli in later stages of acquisition. Longitudinal studies with students majoring or minoring in Portuguese might also be of interest, to determine how acquisition progresses over a longer period; and studies looking at the effect of study abroad programs could also be considered. In sum, there are numerous ways to explore the potential of this particular area of L3 phonological acquisition in an effort to determine its viability as an indicator of acquisition of pronunciation and of interference from other languages.

6.5 Closing

The current study examined the role of the grapheme in the acquisition of pronunciation, in light of the fact that different languages have different GPCRs. This aspect of L2 and L3 acquisition has not received a great deal of attention in the literature to date, yet has been shown here to have a significant impact on accurate production in the target language. Further studies in this area will provide more empirical evidence with regard to common pronunciation mistakes and may provide teachers with useful means of correction, based on learners' linguistic differences.

In addition, it is proposed here that real potential exists for this type of examination in order to determine more precisely the nature of interference from an L3 learner's previous languages. Through future studies examining the role of the L1 and L2 in the acquisition of orthographic-phonological correspondence rules in the L3, it may be possible to gain new insights into how bilingual and multilingual learners organize not only the GPCR systems of their different languages but perhaps also their mental lexicon(s), which would be of great interest to researchers, and potentially very helpful to instructors and learners alike.

APPENDIX A
INFORMED CONSENT FORM

Protocol Title: Developing Pronunciation in Portuguese as a Foreign Language

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study: The purpose of this study is to investigate development in pronunciation in a foreign language class.

What you will be asked to do in the study: You will be asked to read lists of words in English, Spanish and Portuguese, while being audio-recorded.

Time required: No additional time outside of class.

Risks and Benefits: After the study is concluded, you may benefit by receiving feedback concerning your development in pronunciation in Portuguese. There are no risks involved.

Compensation: None.

Confidentiality: Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. The list connecting your name to this number will be kept in a locked office. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used in any report.

Voluntary participation: Your participation in this study is completely voluntary. There is no penalty for not participating and participation will not affect your course grade in any way.

Right to withdraw from the study: You have the right to withdraw from the study at any time without consequence.

Whom to contact if you have questions about the study:

Sharon Barkley, Graduate Student, Linguistics Program, sbarkley@ufl.edu
(Supervisor: Dr. Gillian Lord, Romance Language and Literatures Department, glord@rll.ufl.edu)

Whom to contact about your rights as a research participant in the study:

UFIRB Office, Box 112250, University of Florida, Gainesville, FL 32611-2250; Phone (352) 392-0433

Agreement:

I have read the procedure described above. I voluntarily agree to participate in the procedure and I have received a copy of this description.

Participant: _____ Date: _____

Principal Investigator: _____ Date: _____

APPENDIX B
LANGUAGE BACKGROUND QUESTIONNAIRE

Name: _____ Class: POR _____ Time: _____

The information you provide here will help to inform us about your language experience, enabling us to place you in the right class. Please answer all questions as fully as possible. For the sections on rating your language skills, please refer to the descriptions at the end of this questionnaire.

Sex: _____ Age: _____

Have you ever been diagnosed with a reading disorder (e.g., dyslexia) or speech deficit (e.g., stuttering)? If so, please explain.

Language 1: English

1. Are you a native speaker of English?

2. If not, where did you learn English (at school, somewhere else)? In what grade did you start taking classes in English? How long have you studied English?

3. Where do you currently speak this language (at home, at school, at work)?

4. With whom do you speak this language (parents, grandparents, siblings, spouse, children, co-workers, friends)?

Language 2: Spanish

5. Are you a native speaker of Spanish?

6. Have you had formal instruction in Spanish? In what grade did you start taking classes? How long have you studied Spanish? Have you taken any college classes in Spanish? If so, what level was the last class you took (1000, 2000, 3000 or 4000)?

7. Have you lived in a country or community where Spanish is spoken? If so, explain.

8. Where do you currently speak Spanish (at home, at school, at work)?

9. With whom do you speak Spanish (parents, grandparents, siblings, spouse, children, co-workers, friends)?

10. Please rate your communication skills in Spanish, referring to the descriptions at the end of this questionnaire. Check only ONE number, corresponding to the description which you feel best matches your abilities.

Listening	1	2	3	4
Speaking	1	2	3	4
Reading	1	2	3	4
Writing	1	2	3	4

Language 3: Portuguese

11. Are you a native speaker of Portuguese?

12. Have you had formal instruction in Portuguese? In what grade did you start taking classes? How long have you studied Portuguese? Have you taken any college classes in Portuguese? If so, what level was the last class you took (1000, 2000, 3000 or 4000)?

13. Have you lived in a country or community where Portuguese is spoken? If so, explain.

14. Where do you currently speak Portuguese (at home, at school, at work)?

15. With whom do you speak Portuguese (parents, grandparents, siblings, spouse, children, co-workers, friends)?

16. Please rate your communication skills in Portuguese, referring to the descriptions at the end of this questionnaire. Check only ONE number, corresponding to the description which you feel best matches your abilities. (The descriptions are at the end of this document.)

Listening	1	2	3	4
Speaking	1	2	3	4
Reading	1	2	3	4
Writing	1	2	3	4

Language 4 (please specify): _____

17. Are you a native speaker of this language?

18. Have you had formal instruction in this language? In what grade did you start taking classes? How long have you studied this language? Have you taken any college classes in this language? If so, what level was the last class you took (1000, 2000, 3000 or 4000)?

19. Have you lived in a country or community where this language is spoken? If so, explain.

20. Where do you currently speak this language (at home, at school, at work)?

21. With whom do you speak this language (parents, grandparents, siblings, spouse, children, co-workers, friends)?

22. Please rate your communication skills in this language, referring to the descriptions at the end of this questionnaire. Check only ONE number, corresponding to the description which you feel best matches your abilities.

Listening	1	2	3	4
Speaking	1	2	3	4
Reading	1	2	3	4
Writing	1	2	3	4

Language 5 (please specify): _____

23. Are you a native speaker of this language?

24. Have you had formal instruction in this language? In what grade did you start taking classes? How long have you studied this language? Have you taken any college classes in this language? If so, what level was the last class you took (1000, 2000, 3000 or 4000)?

25. Have you lived in a country or community where this language is spoken? If so, explain.

26. Where do you currently speak this language (at home, at school, at work)?

27. With whom do you speak this language (parents, grandparents, siblings, spouse, children, co-workers, friends)?

28. Please rate your communication skills in this language, referring to the descriptions at the end of this questionnaire. Check only ONE number, corresponding to the description which you feel best matches your abilities.

Listening	1	2	3	4
Speaking	1	2	3	4
Reading	1	2	3	4
Writing	1	2	3	4

Use the following descriptions to rate your language skills for listening, speaking, reading and writing. For each skill, you should choose ONLY the description which you feel best describes your abilities.

Listening

1. I understand only a few isolated words and phrases.
2. I can recognize a number of phrases and can understand simple questions about myself, my activities, my likes and dislikes, as well as other people's conversations about such things. I understand people when they speak slowly and use simple past, present and future tenses
3. I can recognize a number of grammatical structures, including conditional and subjunctive, and I understand vocabulary on a variety of topics, such as the weather, work, studies, films, books and so on. I can understand and follow most directions, I can understand native speakers in a restaurant or store situation.
4. I have an extensive understanding of grammar and vocabulary, and I can understand in-depth conversations on most topics. I can understand a native speaker of any age or social background, and I can understand discussions on topics such as sports, politics and religion.

Speaking

1. I know a few words and phrases but I cannot have a conversation.
2. I know a number of phrases and can have a simple conversation. I can ask people questions about themselves, their likes and dislikes, their usual activities, and I can talk about the same things for myself. I can use simple past, present and future tenses.
3. I know quite a bit of vocabulary and grammar, and I can carry on a conversation on a variety of topics. I can ask for directions and give directions, I can order a meal in a restaurant, I can give my opinion and have a simple discussion on common topics, such as the weather, work, studies, films and so on. I can use a variety of tenses, including conditional and subjunctive.
4. I have extensive knowledge of grammar and vocabulary, and I can carry on in-depth conversations on most topics. I can talk with a native speaker of any age or social background, and I can debate topics such as sports, politics and religion. I can use most tenses with little concern.

Reading

1. I can recognize a few words and phrases but cannot read or understand simple texts without looking up most words in a dictionary.
2. I can get the gist of a simple text, but I need a dictionary to understand all of the words in the text.
3. I can understand a variety of texts with occasional use of a dictionary.
4. I can understand most texts with little use of a dictionary.

Writing

1. I can write a few words and phrases but cannot put them into a grammatically correct sentence.
2. I can write sentences containing simple grammatical structures, on a limited number of topics (descriptions of people, places, activities, and so on).
3. I can write sentences containing complex grammatical structures (including subordinate and relative clauses), in a variety of registers (e-mails, informal letters, compositions).

I can write business letters and academic papers, using a variety of vocabulary and grammatical structures.

APPENDIX C
SUMMARY OF PARTICIPANT QUESTIONNAIRES

Table C-1. Summary of Participant Questionnaires

No	Class_ Per	Sex	Age	Read Dis	Eng	Spn	Spn Origin	Spn L/S/ R/W	Prt Instr	Prt Origin	Prt L/S/ R/W	Oth Lang	Oth Origin	Oth L/S/ R/W
1	1130_3	F	18	N	NNS	NS	DR; Miami; cl in elem & mid sch	4/4/2/2	Yes	Sr yr HS 5 ms; teacher sick; cl cancel	2/1/1/1	French	2 yrs HS	2/1/1/1
2	3010	F	22	N	NNS	NS	Colombia	4/4/4/4	No					
3	1130_3	F	18	N	NS	NS	Up to IB in HS; relatives	3/4/4/3	No					
4	1130_3	F	22	N	NNS	NS	Fr Venezuela	4/4/4/4	No					
5	3010	F	19	N	NS	NNS	Grades 2-5	3/1/3/2	Yes	POR 1130; parents fr Portugal	4/2/3/2	French	HS	3/1/2/2
6	1130_4	F	28	N	NS	NNS	2 yrs HS	2/2/2/2	No					
7	1130_3	M	21	N	NS	NNS	2 yrs HS	1/1/1/1	No					
8	1130_3	F	30	N	NS	None			Yes	Priv lessons; 2 ms Curitiba Urb Reg	1.5/1/1/ 1	French	2 yrs HS	2/1/1/1
9	1130_4	M	18	N	NS	None			No					
10	3010	F	24	N	NS	NNS	SPN 3300	3/3/3/3	No					
11	1130_4	M	18	N	NS	NNS	3 yrs HS	3/3/3/3	Yes	Lev 1 Rosetta Sto	1/2/1/1			
12	3010	F	21	N	NS	NNS	4000 level in Mexico	4/4/3/3	No			French	2000 level	2/1/2/1

Table C-1. Continued

No	Class_ Per	Sex	Age	Read Dis	Eng	Spn	Spn Origin	Spn L/S/ R/W	Prt Instr	Prt Origin	Prt L/S/ R/W	Oth Lang	Oth Origin	Oth L/S/ R/W
13	3010	M	20	N	NS	NNS	3301	3/3/3/4	No					
14	1130_4	F	20	N	NS	NNS	3 yrs HS	2/2/3/2	No			Haitian	NS	4/4/4/3
15	1130_3	M	23	N	NS	NNS	1 coll course	2/1/2/1	No	Brazilian fiance				
16	1130_4	F	22	N	NNS	NS	K-10; El Salv till 15	4/4/4/4	No					
17	1130_4	F	19	N	NS	NNS	Chile, 1-4- y-old	3/2/1/1	No			French	2 yrs HS	2/2/1/1
18	1130_4	M	18	N	NS	None			No			French	4 yrs HS	3/3/3/3
19	1130_3	M	18	N	NNS	NS	Venezuela till 5; IB Spanish	4/4/4/4	No					
20	1130_4	M	18	N	NS	NNS	2 yrs HS	1/1/2/1	No					
21	1130_3	F	19	N	NS	NNS	3 yrs HS	2/2/2/2	No					
22	1130_3	M	19	N	NS	NNS	3 yrs HS	2/2/3/2	No					
23	3010	F	23	N	NS	NNS	Coll major; 7+ yrs study	4/4/4/3	No					
24	1130_4	F	21	N	NS	NNS	4 yrs HS	2/2/2/2	No			Italian	3 coll sem; Italy	3/3/3/3
25	1130_4	M	21	N	NS	NNS	10 days in Peru, 10 in Ecuador	2/2/2/1	No					
26	3010	F	19	N	NS	NNS	2240	3/2/4/3	No					

Table C-1. Continued

No	Class_ Per	Sex	Age	Read Dis	Eng	Spn	Spn Origin	Spn L/S/ R/W	Prt Instr	Prt Origin	Prt L/S/ R/W	Oth Lang	Oth Origin	Oth L/S/ R/W
27	1130_3	F	17	N	NS	NNS	All through school	3/3/3/3	No					
28	1130_3	F	17	N	NS	NNS	K-IB	3/3/3/3	No					
29	1130_3	M	24	N	NS	None			No	Born in Brazil; moved to US at 4	2/2/1/1			
30	1130_4	F	18	N	NS	NNS	2 c1HS	1/1/1/1	No					
31	1130_4	M	18	N	NS	NNS	3 yrs HS	1/1/1/1	No					
32	1130_3	F	19	N	NS	NNS	2 yrs HS	1/1/1/1	No					
33	3010	M	20	N	NS	NNS	9-12 HS	2/1/2/1	Yes	POR 1130; 1/2 family fluent in Port	3/2/3/3	French	2 yrs HS	2/1/2/2
34	3010	F	30	N	NS	None			Yes	Private tutor 3 yrs; 8 ms in Brazil	2/2/2/2			
35	1130_3	F	18	N	NS	NNS	6-12 HS	3/3/3/3	No					
36	1130_4	F	18	N	NS	NNS	7-10 HS	1/2/2/1	No			French	2 yrs HS	2/2/2/2
37	3010	F	20	N	NNS	NS	K-12, Colombia	4/4/4/4	No			French	2241	3/3/3/2
38	1130_3	F	19	N	NS	NNS	3 yrs HS	2/2/3/2	No					
39	3010	M	21	N	NNS	NS	4314; Mexico for 2 yrs	4/4/4/4	No	Visited Brazil a few times	2/1/2/1	French	Lvls 1- 4 HS	3/2/3/2
40	1130_4	M	17	N	NS	NNS	9-10 HS	2/1/2/1	No					

Table C-1. Continued

No	Class_ Per	Sex	Age	Read Dis	Eng	Spn	Spn Origin	Spn L/S/ R/W	Prt Instr	Prt Origin	Prt L/S/ R/W	Oth Lang	Oth Origin	Oth L/S/ R/W
41	1130_4	M	20	N	NS	NNS	7-9 HS	1/1/1/1	No	Born in Br; moved to US at 4; parents only Eng	1/1/1/1			
42	3010	F	18	N	NS	NNS	6 yrs	4/3/4/3	No	Speaks at home with mom	3/3/1/1			
43	3010	F	22	N	NNS	NS	Graduated HS in Colombia	4/4/4/4	No					
44	1130_4	F	18	N	NS	None			No					
45	1130_3	M	18	N	NS	NS	Since 5th grade	4/3/4/3	No					
46	1130_4	M	21	N	NS	NNS	8-12 HS	2/2/2/2	No					
47	1130_4	F	18	N	NS	None			No			French	7-10 HS	3/2/2/2
48	1130_4	M	19	N	NNS	NS	Bolivia for 14 yrs	4/4/4/4	No					
49	1130_3	M	22	N	NS	None			No					
50	3010	F	21	N	NNS	NS	Studied for 6 yrs; Colombia	4/4/4/4	No					
51	1130_3	F	19	N	NS	NNS	10-11 HS	3/2/3/2	No	G'parents used to live in Br; never taught Port				

Table C-1. Continued

No	Class_ Per	Sex	Age	Read Dis	Eng	Spn	Spn Origin	Spn L/S/ R/W	Prt Instr	Prt Origin	Prt L/S/ R/W	Oth Lang	Oth Origin	Oth L/S/ R/W
52	1130_4	M	22	N	NS	NNS	9-10 HS	2/2/1/1	No					

APPENDIX D
WORDS USED IN READING TASKS

Table D-1. Words used in reading tasks

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Portuguese	1	agenda	agenda	C	g	ʒ	N/A	N/A
Portuguese	2	apiterrar	N/A		rr	h	N/A	N/A
Portuguese	3	apresentação	presentation	C	s	z	N/A	N/A
Portuguese	4	arranjar*	to arrange	NC	rr	h	j	ʒ
Portuguese	5	arrogante	arrogant	C	rr	h	N/A	N/A
Portuguese	6	atencioso	attentive	NC	s	z	N/A	N/A
Portuguese	7	audiovisual	audiovisual	C	s	z	N/A	N/A
Portuguese	8	azedo*	sour	NC	z	z	N/A	N/A
Portuguese	9	barreida	N/A	N	rr	h	N/A	N/A
Portuguese	10	básico	basic	C	s	z	N/A	N/A
Portuguese	11	bazerão	N/A	N	z	z	N/A	N/A
Portuguese	12	búzios	shells	NC	z	z	N/A	N/A
Portuguese	13	canja	chicken soup	NC	j	ʒ	N/A	N/A
Portuguese	14	casaco	coat	NC	s	z	N/A	N/A
Portuguese	15	casos	cases	C	s	z	N/A	N/A
Portuguese	16	chato	boring	F	N/A	N/A	N/A	N/A
Portuguese	17	chegar	to arrive	F	N/A	N/A	N/A	N/A
Portuguese	18	chuberrão	N/A	N	rr	h	N/A	N/A
Portuguese	19	ciberrar	N/A	N	rr	h	N/A	N/A
Portuguese	20	colonização	colonization	C	z	z	N/A	N/A
Portuguese	21	compromisso	commitment	F	N/A	N/A	N/A	N/A
Portuguese	22	conjugar	to conjugate	C	j	ʒ	N/A	N/A
Portuguese	23	corresponder	to correspond	C	rr	h	N/A	N/A
Portuguese	24	corrimão*	banister	NC	rr	h	N/A	N/A
Portuguese	25	criança	child	F	N/A	N/A	N/A	N/A

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Portuguese	26	curiosidade	curiosity	C	s	z	N/A	N/A
Portuguese	27	curricular (sg*)	curricular	C	rr	h	N/A	N/A
Portuguese	28	dançar	to dance	F	N/A	N/A	N/A	N/A
Portuguese	29	decisão	decision	C	s	z	N/A	N/A
Portuguese	30	desenho	drawing	NC	s	z	N/A	N/A
Portuguese	31	digital	digital	C	g	ʒ	N/A	N/A
Portuguese	32	disudo	N/A	N	s	z	N/A	N/A
Portuguese	33	divisões	divisions	C	s	z	N/A	N/A
Portuguese	34	dúzia*	dozen	NC	z	z	N/A	N/A
Portuguese	35	endereço	address	F	N/A	N/A	N/A	N/A
Portuguese	36	esquisito	weird	C	s	z	N/A	N/A
Portuguese	37	fechar	to close	F	N/A	N/A	N/A	N/A
Portuguese	38	feijoada	bean stew	NC	j	ʒ	N/A	N/A
Portuguese	39	ferrete	N/A	N	rr	h	N/A	N/A
Portuguese	40	ferrugem*	rust	NC	rr	h	g	ʒ
Portuguese	41	feserel	N/A	N	s	z	N/A	N/A
Portuguese	42	filosofia	philosophy	C	s	z	N/A	N/A
Portuguese	43	garrafa*	bottle	NC	rr	h	N/A	N/A
Portuguese	44	gemotal	N/A	N	g	ʒ	N/A	N/A
Portuguese	45	general	general (mil)	C	g	ʒ	N/A	N/A
Portuguese	46	generosidade	generosity	C	g	ʒ	s	z
Portuguese	47	geral	(in) general	NC	g	ʒ	N/A	N/A
Portuguese	48	gigante*	giant	C	g	ʒ	N/A	N/A
Portuguese	49	givido	N/A	N	g	ʒ	N/A	N/A
Portuguese	50	gizes (pl*)	chalks	NC	g	ʒ	z	z
Portuguese	51	guilajo	N/A	N	j	ʒ	N/A	N/A
Portuguese	52	horizonte	horizon	C	z	z	N/A	N/A

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Portuguese	53	idealização	idealization	C	z	z	N/A	N/A
Portuguese	54	igreja	church	NC	j	ʒ	N/A	N/A
Portuguese	55	iságio	N/A	N	s	z	g	ʒ
Portuguese	56	jaço	N/A	N	j	ʒ	N/A	N/A
Portuguese	57	jade*	jade	C	j	ʒ	N/A	N/A
Portuguese	58	janela	window	NC	j	ʒ	N/A	N/A
Portuguese	59	jantar	dinner	NC	j	ʒ	N/A	N/A
Portuguese	60	jeletida	N/A	N	j	ʒ	N/A	N/A
Portuguese	61	jilão	N/A	N	j	ʒ	N/A	N/A
Portuguese	62	joaninha	ladybug	NC	j	ʒ	N/A	N/A
Portuguese	63	jofiro	N/A	N	j	ʒ	N/A	N/A
Portuguese	64	jornal	newspaper	C	j	ʒ	N/A	N/A
Portuguese	65	junho	June	C	j	ʒ	N/A	N/A
Portuguese	66	justificação	justification	C	j	ʒ	N/A	N/A
Portuguese	67	laginho	N/A	N	g	ʒ	N/A	N/A
Portuguese	68	lazer	leisure	NC	z	z	N/A	N/A
Portuguese	69	localizado	localized	C	z	z	N/A	N/A
Portuguese	70	lomosa	N/A	N	s	z	N/A	N/A
Portuguese	71	manhoso*	smart; whiny	NC	s	z	N/A	N/A
Portuguese	72	maresa	N/A	N	s	z	N/A	N/A
Portuguese	73	moça	young lady	F	N/A	N/A	N/A	N/A
Portuguese	74	mongendo	N/A	N	g	ʒ	N/A	N/A
Portuguese	75	museu	museum	C	s	z	N/A	N/A
Portuguese	76	narrar	to narrate	C	rr	h	N/A	N/A
Portuguese	77	nerneja	N/A	N	j	ʒ	N/A	N/A
Portuguese	78	nirruto	N/A	N	rr	h	N/A	N/A
Portuguese	79	objeto	object	C	j	ʒ	N/A	N/A
Portuguese	80	organização	organization	C	z	z	N/A	N/A
Portuguese	81	origem	origin	C	g	ʒ	N/A	N/A

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Portuguese	82	paimozes	N/A	N	z	z	N/A	N/A
Portuguese	83	pastiza	N/A	N	z	z	N/A	N/A
Portuguese	84	persuasivo	persuasive	C	s	z	N/A	N/A
Portuguese	85	peessoa	person	F	N/A	N/A	N/A	N/A
Portuguese	86	pingente*	pendant	NC	g	ʒ	N/A	N/A
Portuguese	87	pirralho*	child (slang)	NC	rr	h	N/A	N/A
Portuguese	88	poloneses	Polish (plural)	NC	s	z	N/A	N/A
Portuguese	89	preguiçoso	lazy	NC	s	z	N/A	N/A
Portuguese	90	prenegem	N/A	N	g	ʒ	N/A	N/A
Portuguese	91	presidente	president	C	s	z	N/A	N/A
Portuguese	92	pressa	hurry	F	N/A	N/A	N/A	N/A
Portuguese	93	prozida	N/A	N	z	z	N/A	N/A
Portuguese	94	quasano	N/A	N	s	z	N/A	N/A
Portuguese	95	rabicho	N/A	N	r	h	N/A	N/A
Portuguese	96	racial	racial	C	r	h	N/A	N/A
Portuguese	97	ragaria	N/A	N	r	h	N/A	N/A
Portuguese	98	rapazes	boys	NC	r	h	z	z
Portuguese	99	reagir	to react	NC	g	ʒ	r	h
Portuguese	100	real	real	C	r	h	N/A	N/A
Portuguese	101	realizado	realized	C	r	h	z	z
Portuguese	102	reciro	N/A	N	r	h	N/A	N/A
Portuguese	103	refeição	meal	NC	r	h	N/A	N/A
Portuguese	104	região	region	C	r	h	g	ʒ
Portuguese	105	regicó	N/A	N	r	h	g	ʒ
Portuguese	106	regional	regional	C	r	h	g	ʒ
Portuguese	107	relatório	report	NC	r	h	N/A	N/A
Portuguese	108	renalda	N/A	N	r	h	N/A	N/A
Portuguese	109	revisão	revision	C	r	h	s	z

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Portuguese	110	rigor*	rigor	C	r	h	N/A	N/A
Portuguese	111	rinagem	N/A	N	r	h	g	ʒ
Portuguese	112	riscar*	to risk	NC	r	h	N/A	N/A
Portuguese	113	rodumar	N/A	N	r	h	N/A	N/A
Portuguese	114	romântico	romantic	C	r	h	N/A	N/A
Portuguese	115	roxo	purple	NC	r	h	N/A	N/A
Portuguese	116	rua	street	NC	r	h	N/A	N/A
Portuguese	117	rulica	N/A	N	r	h	N/A	N/A
Portuguese	118	rural	rural	C	r	h	N/A	N/A
Portuguese	119	sergipano*	from Sergipe	NC	g	ʒ	N/A	N/A
Portuguese	120	sorridente*	smiling	NC	rr	h	N/A	N/A
Portuguese	121	televisão	television	C	s	z	N/A	N/A
Portuguese	122	território	territory	C	rr	h	N/A	N/A
Portuguese	123	terrível	terrible	C	rr	h	N/A	N/A
Portuguese	124	transição	transition	C	s	z	N/A	N/A
Portuguese	125	trazentar	N/A	N	z	z	N/A	N/A
Portuguese	126	vagem*	green bean	NC	j	ʒ	N/A	N/A
Portuguese	127	visão	vision	C	s	z	N/A	N/A
Portuguese	128	visível	visible	C	s	z	N/A	N/A
Portuguese	129	zalito	N/A	N	z	z	N/A	N/A
Portuguese	130	zangado	angry	NC	z	z	N/A	N/A
English	1	ahead	N/A	N/A	h	h	N/A	N/A
English	2	behalf	N/A	N/A	h	h	N/A	N/A
English	3	bizarre	N/A	N/A	z	z	N/A	N/A
English	4	cohort	N/A	N/A	h	h	N/A	N/A
English	5	decision	N/A	N/A	s	ʒ	N/A	N/A
English	6	decisive	N/A	N/A	s	s	N/A	N/A
English	7	engineer	N/A	N/A	g	dʒ	N/A	N/A
English	8	fusion	N/A	N/A	s	ʒ	N/A	N/A

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
English	9	garage	N/A	N/A	g(e)	ʒ/dʒ	N/A	N/A
English	10	gender	N/A	N/A	g	dʒ	N/A	N/A
English	11	generosity	N/A	N/A	g	dʒ	s	s
English	12	gymnasium	N/A	N/A	g	dʒ	s	z
English	13	happy	N/A	N/A	h	h	N/A	N/A
English	14	heavy	N/A	N/A	h	h	N/A	N/A
English	15	history	N/A	N/A	h	h	N/A	N/A
English	16	hungry	N/A	N/A	h	h	N/A	N/A
English	17	jacket	N/A	N/A	j	dʒ	N/A	N/A
English	18	jelly	N/A	N/A	j	dʒ	N/A	N/A
English	19	journey	N/A	N/A	j	dʒ	N/A	N/A
English	20	judge	N/A	N/A	j	dʒ	dg	dʒ
English	21	leisure	N/A	N/A	s	dʒ	N/A	N/A
English	22	philosophy	N/A	N/A	s	s	N/A	N/A
English	23	physics	N/A	N/A	s	z	N/A	N/A
English	24	pleasure	N/A	N/A	s	ʒ	N/A	N/A
English	25	present	N/A	N/A	s	z	N/A	N/A
English	26	realization	N/A	N/A	r	ɹ	z	z
English	27	reclusive	N/A	N/A	r	ɹ	s	s
English	28	regenerate	N/A	N/A	r	ɹ	g	dʒ
English	29	region	N/A	N/A	r	ɹ	g	dʒ
English	30	reheat	N/A	N/A	r	ɹ	h	h
English	31	result	N/A	N/A	r	ɹ	s	z
English	32	television	N/A	N/A	s	ʒ	N/A	N/A
English	33	treasure	N/A	N/A	s	ʒ	N/A	N/A
English	34	visual	N/A	N/A	s	ʒ	N/A	N/A
English	35	zebra	N/A	N/A	z	z	N/A	N/A
English	36	zipper	N/A	N/A	z	z	N/A	N/A
Spanish	1	antropología	anthropology	N/A	g	h	N/A	N/A

Table D-1. Continued

Language	Number	Word	Gloss	Category	Symbol 1	Sound 1	Symbol 2	Sound 2
Spanish	2	asno	donkey	N/A	s	s/z	N/A	N/A
Spanish	3	caja	box	N/A	j	h	N/A	N/A
Spanish	4	calle	street	N/A	ll	j/ʒ/dʒ	N/A	N/A
Spanish	5	caza	hunt	N/A	z	s	N/A	N/A
Spanish	6	desde	since	N/A	s	s/z	N/A	N/A
Spanish	7	girasol	sunflower	N/A	g	h	s	s
Spanish	8	jardín	garden	N/A	j	h	N/A	N/A
Spanish	9	jefe	boss	N/A	j	h	N/A	N/A
Spanish	10	llamar	to call	N/A	ll	j/ʒ/dʒ	N/A	N/A
Spanish	11	lleno	full	N/A	ll	j/ʒ/dʒ	N/A	N/A
Spanish	12	mismo	same	N/A	s	s/z	N/A	N/A
Spanish	13	refrigerador	refrigerator	N/A	r	r	g	h
Spanish	14	rezar	to pray	N/A	r	r	z	s
Spanish	15	rojo	red	N/A	r	r	j	h
Spanish	16	rollo	roll	N/A	r	r	ll	j/ʒ/dʒ
Spanish	17	zapato	shoe	N/A	z	s	N/A	N/A
Spanish	18	zarpar	to set sail	N/A	z	s	N/A	N/A
Spanish	19	zocato	overripe	N/A	z	s	N/A	N/A
Spanish	20	zumbar	to hum	N/A	z	s	N/A	N/A

APPENDIX E
INSTRUCTION AND SAMPLE SLIDES FOR READING TASK

<p>Thank you for taking part in this activity.</p> <p>You will need to move through a number of slides – in order to do so, press the space bar or Enter key, or click the left mouse button.</p>	<p>In this activity, you will be reading words in Portuguese, English and Spanish. (Even though you may never have taken Portuguese or Spanish, please do not skip those parts of the activity.)</p>	<p>Most of the Portuguese words are real words, but some have been made up for the purpose of this activity. All of the English and Spanish words are real words. <u>Please attempt to read all of the words, even if some of them are unfamiliar.</u></p>
<p>All of the Portuguese words will be presented first, then the English words, and finally the Spanish words. You will be told when the list of words for each language will begin.</p>	<p>Before you start reading, you will be asked to state your name.</p> <p>When you finish reading, you may leave – quietly, please! It is important that you <u>do not close</u> any windows on the computer.</p> <p>The activity should take approximately 10 minutes in total.</p>	<p>Please STOP here, until you are instructed to continue.</p>
<p>Please state your full name.</p>	<p>You will now see a number of words in <u>Portuguese</u>. You should pronounce them however you think is best. Please speak as clearly as possible.</p>	<p>fechar</p>
<p>Well done! You have finished the words in Portuguese.</p> <p>Now you will see a number of words in <u>English</u>. You should pronounce them however you think is best.</p>	<p>reheat</p>	<p>Great! You have finished the words in English.</p> <p>In the last section, you will see a number of words in <u>Spanish</u>. You should pronounce them however you think is best.</p>
<p>caza</p>	<p>Congratulations! You have now finished the activity. You may leave the room quietly, but PLEASE DO NOT CLOSE any windows on the computer.</p> <p>Thank you!!</p>	

Figure E-1. Instruction slides and sample word slides from PowerPoint reading task

APPENDIX F
TRANSCRIPTION GUIDE FOR RATERS

Table F-1. Transcription guide for raters

Language	Grapheme	Symbol for Sound
Portuguese	sapo/calça	s
	casa/zebra	z
	acho	ʃ
	tchau	tʃ
	jacaré	ʒ
	diabo	dʒ
	rato/carro	h
English	sad	s
	design/zebra	z
	show	ʃ
	church	tʃ
	visual	ʒ
	jacket	dʒ
	hospital	h
Spanish	react	r
	zapato/casa	s
	mis mo	s/z
	calle	j/ʃ/ʒ/dʒ
	chico	tʃ
	jefe	h/x/χ
	rollo/perro	r

Recall that the original data set was much larger and included more sounds, but only the sounds [s] and [z] are analysed in this dissertation.

APPENDIX G
RATER TRANSCRIPTION SHEET

Participant Number _____													
Word	E	S	P	O	E	S	P	O	Word	E	S	P	O
PESSOA	s	s	s						ferrete	ʃ	r	h	
persuasivo	s	s	z						audiovisual	ʒ	s	z	
riscar	ʃ	r	h						geral	dʒ	h	ʒ	
jaço	dʒ	h	ʒ		k	k	s		trazentar	z	s	z	
generosidade	dʒ	h	ʒ		s	s	z		território	ʃ	r	h	
general	dʒ	h	ʒ						moça	k	k	s	
jantar	dʒ	h	ʒ						rabicho	ʃ	r	h	tʃ tʃ ʃ
paimozes	z	s	z						disudo	s	s	z	
básico	s	s	z						horizonte	z	s	z	
desenho	s	s	z						jornal	dʒ	h	ʒ	
rulica	ʃ	r	h						vagem	dʒ	h	ʒ	
curricular	ʃ	r	h						guilajo	dʒ	h	ʒ	
racial	ʃ	r	h		ʃ	s	s		regional	ʃ	r	h	dʒ h ʒ
dançar	k	k	s						gizes	dʒ	h	ʒ	z s z
corrimão	ʃ	r	h						pastiza	z	s	z	
nerneja	dʒ	h	ʒ						visível	z	s	z	
presidente	z	s	z						roxo	ʃ	r	h	ks ks ʃ
ferrugem	ʃ	r	h		dʒ	h	ʒ		reciro	ʃ	r	h	
regicó	ʃ	r	h		dʒ	h	ʒ		FECHAR	tʃ	tʃ	ʃ	
narrar	ʃ	r	h						justificação	dʒ	h	ʒ	ʃ k s
dúzia	z	s	z						idealização	z	s	z	ʃ k s
feserel	s	s	z						rapazes	ʃ	r	h	z s z
rigor	ʃ	r	h						givido	dʒ	h	ʒ	
romântico	ʃ	r	h						agenda	dʒ	h	ʒ	
sergipano	dʒ	h	ʒ						feijoadá	dʒ	h	ʒ	
ciberrar	ʃ	r	h						mongendo	dʒ	h	ʒ	
chato	tʃ	tʃ	ʃ						casos	s	s	z	
televisão	ʒ	s	z						lazer	z	s	z	
relatório	ʃ	r	h						rinagem	ʃ	r	h	dʒ h ʒ
iságio	s	s	z		dʒ	h	ʒ		realizado	ʃ	r	h	z s z
divisões	ʒ	s	z						corresponder	ʃ	r	h	
zangado	z	s	z						compromisso	s	s	s	
prozida	z	s	z						atencioso	s	s	z	
organização	z	s	z		ʃ	k	s		bazerão	z	s	z	
conjuguar	dʒ	h	ʒ						esquisito	z	s	z	
manhoso	s	s	z						garrafa	ʃ	r	h	
chuberrão	tʃ	tʃ	ʃ		ʃ	r	h		laginho	dʒ	h	ʒ	
decisão	ʒ	s	z						objeto	dʒ	h	ʒ	
pingente	dʒ	h	ʒ						refeição	ʃ	r	h	k k s
pressa	s	s	s						apiterrar	ʃ	r	h	
barreida	ʃ	r	h						localizado	z	s	z	
jade	dʒ	h	ʒ						transição	z	s	z	ʃ k s
igreja	dʒ	h	ʒ						búzios	z	s	z	
jofiro	dʒ	h	ʒ						jilão	dʒ	h	ʒ	
arrogante	ʃ	r	h						criança	k	k	s	
gigante	dʒ	h	ʒ						real	ʃ	r	h	
reagir	ʃ	r	h		dʒ	h	ʒ		pirralho	ʃ	r	h	

Figure G-1. Rater Transcription Sheet Page 1

Words in capital letters (PESSOA and FECHAR) indicate the start point of the two different PowerPoint versions created for the task.

Word	E	S	P	O	E	S	P	O	Word	E	S	P	O	E	S	P	O
renalda	ɹ	r	h						history	h							
digital	dʒ	h	ʒ						gender	dʒ							
canja	dʒ	h	ʒ						happy	h							
quasano	s	s	z						jacket	dʒ							
junho	dʒ	h	ʒ						decisive	s							
museu	z	s	z						jelly	dʒ							
arranjar	ɹ	r	h		dʒ	h	ʒ		engineer	dʒ							
rodumar	ɹ	r	h						garage	dʒ	ʒ						
região	ɹ	r	h		dʒ	h	ʒ		reheat	ɹ				h			
azedo	z	s	z						physics	z	s						
chegar	tʃ	tʃ	ʃ						result	ɹ				z	s		
jeletida	dʒ	h	ʒ						region	ɹ				dʒ			
colonização	z	s	z		ʃ	k	s		leisure	ʒ							
poloneses	s	s	z						fusion	ʒ							
lomosa	s	s	z						heavy	h							
visão	s	s	z						bizarre	z	s						
curiosidade	s	s	z						journey	dʒ							
sorridente	ɹ	r	h						reclusive	ɹ				s			
gemotal	dʒ	h	ʒ						regenerate	ɹ				dʒ			
terrível	ɹ	r	h						gymnasium	dʒ				z	s		
janela	dʒ	h	ʒ						philosophy	s							
zalito	z	s	z						judge	dʒ							
apresentação	z	s	z		ʃ	k	s		zebra	z	s						
endereço	k	k	s						hungry	h							
casaco	s	s	z						treasure	ʒ							
ragaria	ɹ	r	h						pleasure	ʒ							
rural	ɹ	r	h														
filosofia	s	s	z						zocato	z	s	z					
joaninha	dʒ	h	ʒ						mismo	s	z	z					
nirrito	ɹ	r	h						zumbar	z	s	z					
revisão	ɹ	r	h		ʒ	s	z		desde	s	z	z					
rua	ɹ	r	h						asno	s	z	z					
maresa	s	s	z						girasol	dʒ	h	ʒ		s	s	z	
origem	dʒ	h	ʒ						antropología	dʒ	h	ʒ					
preguiçoso	k	k	s		s	s	z		jardín	dʒ	h	ʒ					
prenegem	dʒ	h	ʒ						zapato	z	s	z					
									calle	l	j	l					
behalf	h								caza	z	s	z					
zipper	z	s							rollo	ɹ	r	h		l	j	l	
cohort	h								refrigerador	ɹ	r	h		dʒ	h	ʒ	
ahead	h								llamar	l	j	l					
generosity	dʒ				s				lleno	l	j	l					
television	ʒ								rezar	ɹ	r	h		z	s	z	
present	z	s							zarpar	z	s	z					
visual	ʒ								caja	dʒ	h	ʒ					
decision	ʒ								jefe	dʒ	h	ʒ					
realization	ɹ				z	s			rojo	ɹ	r	h		dʒ	h	ʒ	

Figure G-2. Rater Transcription Sheet Page 2

English and Spanish words were read only on the first test; for tests 2 and 3, only the Portuguese words appeared on the second page of the transcription sheet.

APPENDIX H
 SAMPLE OF PARTICIPANT PRODUCTION DATA AND ASSIGNED VALUES FOR <Z> AND <S> ITEMS

Table H-1. Sample of participant production data and assigned values for <z> and <s> items

Word	C1	C1	C1	C1	C1	C1	C1	C1	C1
Type									
Grapheme	s	s	s	s	s	s	s	s	s
Value	SYMBOL	TYPE	VALUE	SYMBOL	TYPE	VALUE	SYMBOL	TYPE	VALUE
No	apresentação	apresentação	apresentação	esquisito	esquisito	esquisito	museu	museu	museu
1	s	SP	0	s	SP	0	s	SP	0
2	s	SP	0	s	SP	0	s	SP	0
3	s	SP	0	s	SP	0	s	SP	0
4	s	SP	0	s	SP	0	s	SP	0
5	z	EP	1	z	EP	1	s	SP	0
6	z	EP	1	z	EP	1	s	SP	0
7	z	EP	1	z	EP	1	z	EP	1
8	z	EP	1	z	EP	1	z	EP	1
9	z	EP	1	z	EP	1	s	SP	0
10	z	EP	1	s	SP	0	s	SP	0
11	s	SP	0	s	SP	0	z	EP	1
12	s	SP	0	s	SP	0	s	SP	0
13	s	SP	0	s	SP	0	s	SP	0
14	z	EP	1	s	SP	0	∫	OTH	0
15	s	SP	0	z	EP	1	z	EP	1
16	s	SP	0	s	SP	0	s	SP	0
17	s	SP	0	s	SP	0	s	SP	0
18	s	SP	0	z	EP	1	s	SP	0
19	s	SP	0	z	EP	1	z	EP	1
20	z	EP	1	z	EP	1	z	EP	1
21	z	EP	1	z	EP	1	z	EP	1

APPENDIX I
PERCENTAGES OF CORRECT PRODUCTION BY PARTICIPANT AND GROUP FOR EACH GRAPHEME AND TEST

Table I-1. Percentages of correct production by participant and group for each grapheme and test

Part	Group	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3	All	All	All
		<s> %	<s> %	<s> %	<z> %	<z> %	<z> %	All %	All %	All %	<z> %	<s> %	%
6	E1	24	34	38	42	74	84	31	50	56	67	32	46
7	E1	21	21	24	100	100	100	52	52	54	100	22	53
9	E1	14	14	17	84	79	79	42	40	42	81	15	41
14	E1	7	17	34	32	95	89	17	48	56	72	20	40
17	E1	3	17	24	53	79	84	23	42	48	72	15	38
18	E1	7	38	45	37	84	89	19	56	63	70	30	46
20	E1	48	59	66	95	89	100	67	71	79	95	57	72
21	E1	14	28	24	100	100	100	48	56	54	100	22	53
22	E1	17	34	21	68	79	95	38	52	50	81	24	47
24	E1	10	7	3	74	21	47	35	13	21	47	7	23
25	E1	38	28	41	100	100	100	63	56	65	100	36	61
27	E1	0	0	10	42	74	68	17	29	33	61	3	26
28	E1	0	3	17	68	79	100	27	33	50	82	7	37
30	E1	3	45	24	0	84	74	2	60	44	53	24	35
31	E1	7	14	17	79	68	74	35	35	40	74	13	37
32	E1	17	31	24	89	89	95	46	54	52	91	24	51
35	E1	24	10	14	100	84	89	54	40	44	91	16	46
36	E1	10	45	45	47	89	89	25	63	63	75	33	50
38	E1	14	24	21	95	95	89	46	52	48	93	20	49
40	E1	21	55	38	74	79	84	42	65	56	79	38	54
41	E1	3	14	17	95	95	74	40	46	40	88	11	42
44	E1	14	41	34	89	89	95	44	60	58	91	30	54
46	E1	34	31	34	89	95	100	56	56	60	95	33	58
47	E1	41	48	52	89	79	100	60	60	71	89	47	64

Table I-1. Continued

Part	Group	Test 1 <s> %	Test 2 <s> %	Test 3 <s> %	Test 1 <z> %	Test 2 <z> %	Test 3 <z> %	Test 1 All %	Test 2 All %	Test 3 All %	All <z> %	All <s> %	All %
49	E1	31	52	38	100	100	100	58	71	63	100	40	64
51	E1	28	34	17	84	84	74	50	54	40	81	26	48
52	E1	17	17	10	74	89	89	40	46	42	84	15	42
E1 Average		17	28	28	74	84	88	40	50	51	82	24	47
10	E2	3	14	38	32	47	84	15	27	56	54	18	33
12	E2	0	3	24	21	74	79	8	31	46	58	9	28
13	E2	3	31	55	16	58	79	8	42	65	51	30	38
23	E2	0	14	24	5	53	95	2	29	52	51	13	28
26	E2	28	28	21	89	95	100	52	54	52	95	25	53
E2 Average		7	18	32	33	65	87	17	37	54	62	19	36
1	P	0	17	28	21	37	68	8	25	44	42	15	26
5	P	31	24	38	89	100	89	54	54	58	93	31	56
8	P	28	24	21	95	89	84	54	50	46	89	24	50
11	P	24	24	31	84	68	74	48	42	48	75	26	46
15	P	31	48	59	95	100	100	56	69	75	98	46	67
29	P	45	59	69	100	100	100	67	75	81	100	57	74
33	P	41	52	55	74	79	95	54	63	71	82	49	63
34	P	52	55	66	95	100	100	69	73	79	98	57	74
42	P	21	45	52	37	74	95	27	56	69	68	39	51
P Average		30	39	46	77	83	89	49	56	63	83	38	56
2	S	3	3	14	5	26	68	4	13	35	33	7	17
3	S	0	0	7	0	11	32	0	4	17	14	2	7
4	S	3	0	0	16	26	16	8	10	6	19	1	8
16	S	0	0	0	5	5	11	2	2	4	7	0	3
19	S	31	48	34	58	89	84	42	65	54	77	38	53
37	S	7	21	79	5	58	89	6	35	83	51	36	42
39	S	55	41	41	95	95	95	71	63	63	95	46	65
43	S	0	3	7	0	5	37	0	4	19	14	3	8

Table I-1. Continued

Part	Group	Test 1 <s> %	Test 2 <s> %	Test 3 <s> %	Test 1 <z> %	Test 2 <z> %	Test 3 <z> %	Test 1 All %	Test 2 All %	Test 3 All %	All <z> %	All <s> %	All %
45	S	0	7	3	37	37	53	15	19	23	42	3	19
48	S	10	28	10	21	21	11	15	25	10	18	16	17
50	S	0	24	28	0	63	74	0	40	46	46	17	28
S Average		10	16	20	22	40	52	15	25	33	38	15	24

APPENDIX J
 PRODUCTION ON SPANISH READING TASK AND AVERAGE PRODUCTION ON
 PORTUGUESE READING TASKS

Table J-1. Production on Spanish reading task and average production on Portuguese reading tasks

Part	Group	Accuracy on Spanish Items %	Average Accuracy on Portuguese Items %
44	E1	5	54
41	E1	9	42
8	P	14	50
5	P	18	56
15	P	18	67
32	E1	18	51
25	E1	23	61
34	P	23	74
47	E1	23	64
33	P	27	63
7	E1	32	53
17	E1	32	38
29	P	36	74
51	E1	36	48
52	E1	36	42
9	E1	41	41
21	E1	41	53
31	E1	41	37
18	E1	45	46
46	E1	45	58
20	E1	50	72
35	E1	50	46
38	E1	50	49
49	E1	50	64
14	E1	59	40
22	E1	59	47
26	E2	59	53
40	E1	59	54
42	P	64	51
4	S	68	8
6	E1	68	46
24	E1	68	23
36	E1	68	50

Table J-1. Continued

Part	Group	Accuracy on Spanish Items %	Average Accuracy on Portuguese Items %
45	S	68	19
27	E1	82	26
11	P	86	46
28	E1	86	37
48	S	86	17
12	E2	91	28
30	E1	91	35
50	S	95	28
1	P	100	26
2	S	100	17
3	S	100	7
10	E2	100	33
13	E2	100	38
16	S	100	3
19	S	100	53
23	E2	100	28
37	S	100	42
39	S	100	65
43	S	100	8

The results are ordered according to accuracy on the Spanish reading task.

APPENDIX K
 PERCENTAGES OF PRODUCTION BY PARTICIPANT FOR EACH PRODUCTION TYPE
 AND GRAPHEME

Table K-1. Percentages of Production by Participant for Each Production Type and Grapheme

Part	Group	EN	EP	ES	NO	OTH	PO	SP	EP	NO	OTH	SP
		<s>	<z>	<z>	<z>	<z>						
6	E1	0	10	51	1	2	22	14	67	4	0	30
7	E1	3	16	59	0	0	6	16	100	0	0	0
9	E1	1	10	61	0	0	5	23	81	2	12	5
14	E1	2	5	52	0	8	15	18	72	2	2	25
17	E1	1	7	54	1	2	8	26	72	4	4	21
18	E1	1	10	53	0	1	20	15	70	0	18	12
20	E1	3	17	36	0	0	40	3	95	0	2	4
21	E1	1	14	60	0	0	8	17	100	0	0	0
22	E1	1	15	55	0	0	9	20	81	5	0	14
24	E1	0	7	62	0	1	0	30	47	2	18	33
25	E1	3	16	54	0	0	20	7	100	0	0	0
27	E1	0	0	59	0	0	3	38	61	2	0	37
28	E1	0	0	54	2	0	7	37	82	4	0	14
30	E1	1	6	54	0	0	18	21	53	0	0	47
31	E1	7	8	60	0	1	5	20	74	4	7	16
32	E1	3	11	57	0	0	13	15	91	0	0	9
35	E1	1	9	56	0	1	7	25	91	5	0	4
36	E1	3	9	47	0	0	24	16	75	4	2	19
38	E1	1	11	57	0	1	8	21	93	0	2	5
40	E1	2	16	51	0	0	22	9	79	0	0	21
41	E1	10	6	57	6	2	6	13	88	2	2	9
44	E1	1	10	47	5	3	20	14	91	7	0	2
46	E1	3	10	54	1	2	23	6	95	0	0	5
47	E1	2	17	44	0	0	30	7	89	0	2	9
49	E1	0	15	53	0	0	25	7	100	0	0	0
51	E1	3	14	53	0	3	13	14	81	0	2	18
52	E1	2	7	57	1	0	8	24	84	0	0	16
10	E2	0	8	52	0	3	10	26	54	0	0	46
12	E2	0	1	54	0	0	8	37	58	0	0	42
13	E2	0	9	43	0	0	21	28	51	4	0	46
23	E2	0	5	55	0	0	8	32	51	4	5	40
26	E2	0	13	59	1	0	13	15	95	0	0	5
1	P	0	2	55	0	2	13	28	42	0	4	54
5	P	3	11	49	1	0	20	15	93	2	0	5
8	P	10	16	61	0	0	8	5	89	0	5	5

Table K-1. Continued

Part	Group	EN <s>	EP <s>	ES <s>	NO <s>	OTH <s>	PO <s>	SP <s>	EP <z>	NO <z>	OTH <z>	SP <z>
11	P	3	7	49	0	0	20	21	75	4	7	14
15	P	7	16	40	1	0	30	6	98	0	0	2
29	P	0	14	36	0	0	44	7	100	0	0	0
33	P	0	15	47	0	1	34	2	82	0	2	16
34	P	0	14	32	0	0	44	10	98	0	0	2
42	P	2	13	45	0	1	26	13	68	0	0	32
2	S	0	0	56	0	0	7	37	33	0	2	65
3	S	0	1	61	0	0	1	37	14	2	0	84
4	S	1	0	62	1	5	1	30	19	0	12	68
16	S	0	0	62	0	0	0	38	7	0	0	93
19	S	0	9	47	0	0	29	15	77	0	0	23
37	S	0	11	45	0	0	24	20	51	7	0	42
39	S	1	13	39	0	0	33	14	95	0	0	5
43	S	0	0	59	0	0	3	38	14	0	0	86
45	S	1	2	61	0	0	1	34	42	2	2	54
48	S	0	6	56	0	0	10	28	18	0	0	82
50	S	0	3	55	0	0	14	28	46	0	0	54

APPENDIX L
PERCENTAGES OF PRODUCTION BY PRODUCTION TYPE FOR EACH WORD

Table L-1. Percentages of Production by Production Type for Each Word

Word	Type	English sound	EN %	EP %	ES %	NO %	OTH %	PO %	SP %
apresentação	C	[z]	0	53	0	0	0	0	47
esquisito	C	[z]	0	47	0	3	1	0	49
museu	C	[z]	0	47	0	0	1	0	53
presidente	C	[z]	0	68	0	0	1	0	31
visível	C	[z]	0	46	0	2	0	0	53
básico	C	[s]	0	0	92	0	1	8	0
casos	C	[s]	0	0	73	0	0	27	0
curiosidade	C	[s]	0	0	93	1	0	6	0
filosofia	C	[s]	0	0	97	1	0	2	0
generosidade	C	[s]	0	0	99	0	0	1	0
persuasivo	C	[s]	0	0	92	3	0	6	0
audiovisual	C	[ʒ]	35	0	0	0	8	28	30
decisão	C	[ʒ]	3	0	0	1	4	27	66
divisões	C	[ʒ]	1	0	0	0	1	13	85
revisão	C	[ʒ]	2	0	0	0	0	35	63
televisão	C	[ʒ]	5	0	0	0	1	37	57
visão	C	[ʒ]	5	0	0	0	1	48	46
disudo	N		0	0	87	0	0	13	0
feserel	N		0	0	80	0	1	19	0
iságio	N		0	0	76	0	0	24	0
lomosa	N		0	0	89	0	0	11	0
maresa	N		0	0	83	0	0	17	0
quasano	N		0	0	77	0	1	22	0
atencioso	NC		0	0	87	1	1	10	0
casaco	NC		0	0	70	1	1	29	0
desenho	NC		0	0	72	0	1	27	0
manhoso	NC		0	0	94	0	0	6	0
poloneses	NC		0	0	81	0	0	19	0
preguiçoso	NC		0	0	84	1	2	13	0
idealização	C		0	62	0	15	0	0	23
localizado	C		0	67	0	0	1	0	33
organização	C		0	71	0	4	1	0	24
realizado	C		0	71	0	0	2	0	27
colonização	C		0	67	0	4	1	0	28
horizonte	C		0	86	0	0	0	0	14
bazerão	N		0	71	0	0	0	0	29

Table L-1. Continued

Word	Type	English sound	EN %	EP %	ES %	NO %	OTH %	PO %	SP %
paimozes	N		0	53	0	0	3	0	44
prozida	N		0	77	0	0	2	0	21
trazentar	N		0	83	0	0	1	0	15
pastiza	N		0	70	0	1	8	0	21
zalito	N		0	79	0	0	1	0	20
azedo	NC		0	79	0	0	1	0	20
búzios	NC		0	66	0	0	4	0	29
dúzia	NC		0	73	0	1	4	0	22
gizes	NC		0	65	0	0	2	0	33
lazer	NC		0	77	0	0	1	0	22
rapazes	NC		0	55	0	0	6	0	39
zangado	NC		0	74	0	0	1	0	25

APPENDIX M
PERCENTAGES OF PRODUCTION BY WORD

Table M-1. Percentages of Production by Word

Word	Grapheme	Word Type	English Cognate <s> Sound	Accuracy (Raw Scores)	Accuracy (Percentage)
apresentação	<s>	C	[z]	83	53
esquisito	<s>	C	[z]	74	47
museu	<s>	C	[z]	73	47
presidente	<s>	C	[z]	106	68
visível	<s>	C	[z]	71	46
básico	<s>	C	[s]	12	8
casos	<s>	C	[s]	42	27
curiosidade	<s>	C	[s]	10	6
filosofia	<s>	C	[s]	3	2
generosidade	<s>	C	[s]	1	1
persuasivo	<s>	C	[s]	9	6
audiovisual	<s>	C	[ʒ]	43	28
decisão	<s>	C	[ʒ]	42	27
divisões	<s>	C	[ʒ]	20	13
revisão	<s>	C	[ʒ]	55	35
televisão	<s>	C	[ʒ]	58	37
visão	<s>	C	[ʒ]	75	48
disudo	<s>	N		20	13
feserel	<s>	N		30	19
iságio	<s>	N		38	24
lomosa	<s>	N		17	11
maresa	<s>	N		26	17
quasano	<s>	N		35	22
atencioso	<s>	NC		16	10
casaco	<s>	NC		45	29
desenho	<s>	NC		42	27
manhoso	<s>	NC		10	6
poloneses	<s>	NC		30	19
preguiçoso	<s>	NC		21	13
idealização	<z>	C		97	62
localizado	<z>	C		104	67
organização	<z>	C		110	71
realizado	<z>	C		111	71
colonização	<z>	C		104	67
horizonte	<z>	C		134	86

Table M-1. Continued

Word	Grapheme	Word Type	English Cognate <s> Sound	Accuracy (Raw Scores)	Accuracy (Percentage)
bazerão	<z>	N		110	71
paimozes	<z>	N		83	53
prozida	<z>	N		120	77
trazentar	<z>	N		130	83
pastiza	<z>	N		109	70
zalito	<z>	N		124	79
azedo	<z>	NC		123	79
búzios	<z>	NC		103	66
dúzia	<z>	NC		114	73
gizes	<z>	NC		102	65
lazer	<z>	NC		120	77
rapazes	<z>	NC		86	55
zangado	<z>	NC		116	74

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