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IMPROVING PRONUNCIATION INSTRUCTION IN THE SECOND LANGUAGE CLASSROOM

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ABSTRACT

In the last three decades, researchers in second language acquisition (SLA) have increasingly discussed the role that attention plays in the learning of a second language (L2). This discussion has led to research on proposed pedagogical strategies aimed at directing L2 learners' attention to aspects of the L2 grammar that are difficult to learn or acquire. Research on one such strategy, Processing Instruction (Cadierno, 1995; VanPatten and Cadierno, 1993a, 1993b; VanPatten and Wong, 2004), suggests that focusing learners' attention on certain grammatical forms in the input can lead to the learners' improvement in both the comprehension and production of those grammatical forms. However, studies regarding the role of attention in SLA, including those on Processing Instruction, have focused primarily on morphology and syntax, while the relationship between attention and pronunciation learning has been mostly ignored. Other research has focused on the impact that explicit instruction on L2 phonetics and phonology has on L2 learners' improvement in pronunciation (e.g. Elliott, 1995b, 1997; Lord, 2005), but this research has not considered the role that attention may play in pronunciation learning.

This dissertation connects research on pronunciation learning with other research in SLA by comparing a more typical type of pronunciation assignment with a pronunciation assignment designed to encourage students to attend to the fine-grained phonetic details of L2 speech sounds. Specifically, native English-speaking learners of Spanish were tested on their learning of the Spanish vowels /e/ and /o/. These sounds were considered specifically because previous research has focused on them less than other Spanish sounds. Moreover, earlier studies have not attempted to quantify diphthongization of these vowels to better analyze learners' improvement on them. Twenty-eight students of Spanish, enrolled in two separate sections of a Spanish conversation class, participated in the study. The two sections were taught identically, except

that one section received the more typical pronunciation assignment (production assignment, N = 15), while the other received the pronunciation assignment designed to focus students' attention on L2 speech sounds (perception assignment, N = 13). In addition, all students were recorded reading single words at the beginning (pretest) and end (posttest) of the semester. The impact of each assignment on improvement in pronunciation was assessed by acoustically analyzing each student's pronunciation of the vowels /e/ and /o/ on both the pretest and posttest.

Both sections were given explicit instruction on differences in Spanish and English speech sounds that have been identified in past studies as difficult for English learners of Spanish. This included instruction on the sounds /e, o, a, p, t, k, b, d, g, ɾ, l/ in Spanish. The production assignment, administered five times, required students to submit recordings of themselves reading a dialogue, on which they received feedback regarding their pronunciation from the instructor each time. For the perception assignment, also administered five times, students listened to recordings of native English participants speaking Spanish and were asked to evaluate the speaker's pronunciation. All native English speakers were unknown to the students receiving the perception assignment. For all assignments in both sections, focus was given to the aspects of Spanish pronunciation covered in class to that point.

To analyze students' improvement of the mid vowels, diphthongization of these vowels was quantified. From participants' productions on the pretest and posttest, the first (F1) and second (F2) formants were measured throughout the production of each critical mid vowel, and the change in F1, as well as the change in F2-F1 (F2 minus F1), was calculated. Diphthongization of the /o/ vowel was measured by the decrease in F1, while diphthongization of the /e/ vowel was measured by the increase in F2-F1. Improvement in production of the mid vowels was indicated by a reduction in these changes in F1 and F2-F1 from the pretest to the posttest. This technique allowed for a more in depth analysis of improvement than would be obtained from labeling each vowel as a diphthong or monophthong.

Results show a significant improvement in the diphthongization of both /o/ and /e/ for the section receiving the perception assignment, but they show no improvement on either vowel for the section receiving the production assignment. This finding suggests that the perception assignment used here was superior to the production assignment inasmuch as the two assignments are compared in this study. I argue that the perception assignment led to more improvement in pronunciation because it was designed to direct students' attention to L2 pronunciation in a way that is not required of students to complete the production assignment. This implies that attention not only plays a role in the learning of morphology and syntax, but also in the learning of pronunciation. The findings in this dissertation suggest, then, that when teachers design assignments targeting pronunciation in L2 classrooms, they should consider how or whether the assignments direct students' attention to key aspects of the L2 speech sounds.

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Chapter 1

Introduction and Background

1.1 Introduction

Almost anyone who has learned or taught a foreign language is aware that pronunciation is one of the most difficult aspects of a new language to acquire. This is evident through the observation that proficient speakers of a second language (L2) rarely acquire a pronunciation comparable to that of a native speaker, even after being immersed in the second language environment for a lengthy period of time. We know, however, that classroom instruction, and in particular instruction that focuses learners' attention on particular aspects of the input (Cadierno, 1995; Van Patten and Cadierno, 1993a, 1993b; VanPatten and Wong, 2004) has been effective in helping learners acquire features of the L2 that are particularly difficult. This dissertation extends these findings to the domain of phonology by examining the impact of instruction that focuses learner's attention on L2 phonetics on learners' improvement in pronunciation.

There is evidence that classroom instruction not only benefits learners in the area of morphosyntax but also in the area of phonology (e.g. Derwing, Munro and Wiebe, 1998; Elliott, 1995b, 1997; Lord, 2005). These studies, however, leave much to be researched in the area of second language pronunciation learning. One shortcoming is that these studies are not based on and make no connection to second language acquisition (SLA) theories, models or research, such as research on attention or theories on input and intake. Another drawback to previous research studies on pronunciation learning is that in those studies, the instruction required a considerable portion of class time. Knowing that teaching and training strategies can lead to second language learners' (SLLs') improvement in pronunciation is worthwhile, but research should also seek to

find methods that can easily be integrated into current L2 curricula to help students improve their pronunciation. Furthermore, these previous studies focus primarily on whether or not there is improvement (e.g. Elliott, 1997), or on different types of improvement (e.g. fluency, comprehensibility and accentedness in Derwing et al., 1998) rather than on the degree of improvement attained. Now that we know it is possible to help students improve their pronunciation, efforts should be made to learn which methods help students maximize their improvement in pronunciation.

This dissertation addresses these issues and furthers our knowledge of ways to implement pronunciation teaching in the L2 classroom. The present study draws from research on attention in second language acquisition and attempts to find parallels between the role of attention in learning morphosyntactic aspects of language and its role in L2 pronunciation learning. The study also seeks to find strategies that help to maximize students' improvement in pronunciation while minimizing the use of valuable class time. To this end, this study proposes a pronunciation assignment that is designed to direct students' attention to L2 pronunciation and which requires little time in class. The primary purpose of this dissertation is to compare this novel assignment (i.e. a perception-oriented assignment) designed to direct students' attention to L2 sounds with an assignment based on a more typical ideology for teaching and correcting pronunciation; namely, a procedure in which instructors inform learners of how their pronunciation deviates from the target so that the learners will use this information to improve their pronunciation (represented here by a production-based assignment). I argue that, similar to findings from studies on other aspects of L2 learning (Cadierno, 1995; VanPatten and Cadierno, 1993a, 1993b; VanPatten and Wong, 2004), a perception-based assignment that focuses students' attention on the necessary aspects of the input (L2 phonetics in this study) can lead to improvement in production, even when the instruction and the assignment do not explicitly focus attention on production.

In this chapter, I first review relevant literature on the role of attention in SLA (1.2). I then describe key differences in English and Spanish phonetics and phonology (1.3) before reviewing previous studies that have sought to improve students' L2 pronunciation through classroom instruction on phonetics and phonology (1.4). Next, I discuss what is currently lacking in the literature on classroom pronunciation teaching and provide rationale for the study presented here (1.5). Then, I describe the present study and outline how it fills a number of gaps in the current SLA literature (1.5). Finally, I lay out the research questions and hypotheses of the study (1.6). In subsequent chapters, I provide a detailed description of the methodology for the study (chapter 2), followed by a presentation of the results (chapter 3). In the final chapter, I discuss the meaning of the results and their implications for language learning and language pedagogy (chapter 4). The final chapter (chapter 4) closes with a summary of the dissertation, reviewing its purpose, findings and implications.

Before delving into the first part, there are a few key clarifications to be made that apply to the dissertation as a whole. The main aim of this study is to help students improve their L2 pronunciation. One should not expect, however, that students will acquire a *native-like pronunciation*, because this is rarely achieved by adult SLLs. Even learners who achieve a very high level of proficiency in morphology and syntax usually retain a noticeable non-native accent. However, the prototypical ideal for pronunciation improvement in this dissertation is a neutral (or standard) native-like pronunciation. Even if this cannot be achieved, surely one's goal in L2 pronunciation learning is to approximate a pronunciation as close to the native ideal as possible.

Three additional clarifications should be made regarding terminology in the dissertation. One is that the term *instruction* is used in this dissertation to refer not only to in-class explanations, but also to in-class activities, out-of-class assignments, and out-of-class explanations and readings. Second, terms such as *second language learners (SLLs)*, *English speakers* and *Spanish speakers* are used frequently throughout the dissertation. In such cases, for

the purpose of the study presented here, an "English speaker" refers to a native speaker of American English, primarily with reference to speakers of the standard variety. "Spanish speakers" refer to native speakers of any dialect of Spanish. For simplification, a "second language learner" (SLL), when used here in the context of learning Spanish, specifically denotes a native speaker of American English that is learning the variety of Spanish typically taught in classrooms in the United States. However, findings that apply to English-speaking learners of Spanish do not necessarily apply to speakers of other native languages learning other second languages. A final clarification to be made is that while the phonetics and phonology of different dialects of Spanish can vary widely, "native-like Spanish pronunciation," and any other similarly-used term, refers here to particular characteristics of Spanish pronunciation that are consistent across dialects. For example, one difference between English and Spanish mid vowels (i.e. /e/ and /o/) is that the English ones are diphthongs (see 1.3) while the Spanish ones are monophthongs. Regardless of the exact quality of these vowels, which may vary across dialects, most native Spanish speakers always articulate these vowels as monophthongs. Therefore, regardless of vowel quality, less diphthongized articulations of /e/ and /o/ are considered to be more *native-like* (i.e. they more closely resemble *native-like Spanish pronunciation*).

1.2 Attention in SLA

Researchers in SLA have become increasingly interested in attention over the last few decades because of the potential role it plays in learning. This review centers specifically around research on the connection between attention and learning, especially with a primary interest in

its implications for SLA[1]. The sections that follow briefly discuss the role of attention in SLA and the theories and classroom strategies that have developed as a result of research and discussions on attention in SLA.

1.2.1 Does attention play a role in SLA?

Most early theories of attention in SLA assumed that attention did not play an important role in learning. Behaviorists, for example, believed that all learning was a subconscious process that functioned independently of attention (Schmidt, 1990). Similarly, Seliger (1983) argued that language acquisition is an unconscious process, and Krashen (1985) posited that attention and instruction are irrelevant for language acquisition. Even today, there are some researchers who, taking a Chomskyan view of language acquisition (Chomsky, 1965, 1980, 1986), believe that Universal Grammar, and not attention, underlies language acquisition (White, 1989; Eubank, 1991).

However, in recent years, several SLA researchers have acknowledged that attention plays an important role in language acquisition. Most notably, Schmidt (1990, 1993, 1994, 1995, 2001) has argued that noticing is the necessary and sufficient requirement for language learning to take place. Schmidt has defined his term *noticing* as referring to the detection of a stimulus and being aware of having detected it. In other words, as argued by Al-Hejin (2004), Schmidt's *noticing* is more or less equivalent to *awareness* itself, given that one must have detected a stimulus to be aware of having detected it. Schmidt (1993), himself, equated his *noticing* to Gass's (1988; see also Gass and Selinker, 2008) *apperception*, as well as to Tomlin and Villa's

[1] For more in depth reviews of research on attention, see Allport (1993), Anderson (1995), Shiffrin (1988), Tomlin and Villa (1994) and Wickens (1992), and for a review of and proposals for definitions and terminology, see Schmidt (1994).

(1994) *detection within selective attention*, and Robinson's (1995) *detection plus rehearsal in short term memory*. Gass (1988) has acknowledged that attention plays an important role in language learning but has also suggested that not all acquisition results from attention because it can also arise from access to Universal Grammar. Whether access to Universal Grammar plays a role in SLA is not of importance to the discussions here nor to the study presented in this dissertation, so it will not be considered further in this review. It should be noted, however, that it is generally accepted that some learning may take place without awareness (i.e. *implicit learning*, see Schmidt, 1990, 1993, 2001), though it is debatable and unclear whether L2 learning ever happens without attention.

Within the discussion on the role of attention in learning, and in SLA specifically, there has been debate over what aspects of the attentional system must be involved and over what can and cannot be learned with or without attention. For example, many have argued (Al-Hejin, 2004; Truscott, 1998) that Schmidt's initial claim that noticing (i.e. awareness) is absolutely necessary for learning is too strong, given evidence that implicit learning can take place without awareness (Cohen, Ivry, and Keele, 1990; Hartman, Knopman, and Nissen, 1989; Marcel, 1983; Nissen and Bullemer, 1987). However, there have been several claims that increased attention or awareness leads to increased learning (Allport, Antonis and Reynolds, 1972; Curran and Keele, 1993; Eich, 1984; Kellogg, 1980, Nissen and Bullemer, 1987, Reber, 1967). In fact, Kellogg and Dare (1989) argue that unattended information does not affect human cognition or behavior in a significant way. This argument suggests that even if *some* form of learning may take place without attention, learning should be enhanced when it involves attention. Furthermore, Gass and Selinker (2008) comment that "it is widely accepted that selective attention plays a major role in learning," (p. 355) and this *learning* is meant to include the context of *language learning*. This discussion on the role of attention in SLA has led to pedagogical strategies that attempt to focus

students' attention on target grammatical forms. In the next section, I discuss two methodologies in particular that have received much attention in empirical studies.

1.2.2 Classroom strategies for focusing attention

Because of suggestions in the literature that attention facilitates learning, researchers have proposed teaching methodologies and strategies that address attention in the classroom for language instruction. Here, I review two strategies that have received much attention in the literature: Processing Instruction (Sanz and VanPatten, 1998; VanPatten, 1996, Chapter 3; VanPatten and Cadierno, 1993a, 1993; Wong, 2004), and Input Enhancement (Sharwood Smith, 1991, 1993). I discuss each of these in turn below.

1.2.2.1 Processing Instruction

Processing Instruction (Sanz and VanPatten, 1998; VanPatten, 1996, Chapter 3; VanPatten and Cadierno, 1993a, 1993; Wong, 2004) is a focus-on-form strategy based on VanPatten's (1996, Chapter 2, 2004, 2007) theory of Input Processing. For this reason, a summary of Processing Instruction must begin with a discussion on Input Processing. With growing concern regarding the role of attention in SLA, VanPatten found and argued that SLLs cannot attend to both form and meaning simultaneously – a hypothesis for which empirical support is found in VanPatten (1990). This finding led to a formally proposed theory of Input Processing (VanPatten, 1996, Chapter 2, 2004, 2007), which Sanz and VanPatten (1998) describe as a psycholinguistic theory of the way SLLs attend to and process linguistic input and convert it to intake. Based on observations and research findings regarding what SLLs learn from L2 input, VanPatten has proposed several principles for the theory of Input Processing (see VanPatten,

2007 for the most recent versions). Some of the principles most relevant for this dissertation are mentioned here briefly. These include the *Primacy of Content Words Principle*, the *Lexical Preference Principle*, the *Preference for Nonredundancy Principle*, and the *Meaning before Nonmeaning Principle* (VanPatten, 2007).

The *Primacy of Content Words Principle* states that "learners process content words in the input before anything else" (VanPatten 2007: 117). The primary suggestion behind this principle is that when learners in beginning stages encounter L2 input, they look for *meaning* in the input (Færch and Kasper, 1986; Krashen, 1982). Their primary objective is not to recognize verbal or adjectival inflections in the input but rather to *understand* the input, which arguably requires recognizing content words; that is, words that carry meaning.

The *Lexical Preference Principle* proposes that "learners will process lexical items for meaning before grammatical forms when both encode the same semantic information" (VanPatten 2007: 118). For example, in a sentence like "I paid the bill yesterday," learners will not process the past tense allomorph [d] because they will process the adverb "yesterday" to understand the tense. More importantly, because "yesterday" encodes past tense so saliently, processing of the past tense verbal morphology is redundant for comprehension.

The *Preference for Nonredundancy Principle* suggests that "learners are more likely to process nonredundant meaningful grammatical markers before they process redundant meaningful markers" (VanPatten 2007: 119). As suggested by the *Lexical Preference Principle* above, learners will not process redundant grammatical information in initial stages of learning. However, this does not imply that learners never process grammatical markers. The *Preference for Nonredundancy Principle* explains this notion further by adding that learners are more likely, in fact, to process grammar markers when they are not redundant. An example given by VanPatten (2007: 119) is that of the *–ing* morpheme in English, which encodes progressive aspect, an aspect that cannot be encoded lexically. This principle suggests, then, that in a

sentence like "the boy is walking," learners are likely to attend to and process the *–ing* morpheme and interpret the progressive aspect.

The *Meaning before Nonmeaning Principle* states that "learners are more likely to process meaningful grammatical markers before nonmeaningful grammatical markers" (VanPatten 2007: 120). With this principle, attention is turned to the existence of grammatical markers that carry no semantic meaning. VanPatten (2007: 119-120) mentions as an example the word *that* (i.e., as a complementizer, not as a determiner) in English and the morphological agreement between nouns and adjectives in Spanish. In a sentence like "I think that he fell off a donkey," the word *that* serves the grammatical role of introducing a subordinate clause, but it carries no semantic information, i.e., meaning. Likewise, morphological agreement between nouns and adjectives in Spanish (e.g. ***la*** *sill**a*** *roj**a*** "the red chair" and *el cuadern**o*** *roj**o*** "the red notebook") is a purely grammatical phenomenon. Whether the word for "red" in Spanish ends in *–o* or *–a* (i.e., *rojo* or *roja*, respectively) does not change the meaning of the word. Previous principles state that grammatical elements are less likely to be processed if their meaning can be extracted from lexical items. The *Meaning before Nonmeaning Principle* extends this idea by suggesting that if and when grammatical elements are processed, those that carry meaning are processed before those that do not.

There are other important principles to VanPatten's (1996, 2004, 2007) theory of Input Processing (e.g. the often-cited *First Noun Principle*), but the four described above provide a backdrop to the discussion here. The primary objective of a SLL is to extract meaning from L2 input. They will search for meaning in content words rather than in purely grammatical elements because content words are more salient. If and when learners notice and process grammatical elements in the input, they will first process forms that carry meaning when content words do not carry the same meaning. Only once initial stages of L2 processing have been developed sufficiently to allocate attentional resources to additional aspects of the input will learners process

redundant grammatical forms that carry the same meaning as content words in the same sentence (or string of speech or words). Finally, grammatical elements that carry no semantic meaning will be processed last, once all other types of grammatical markers have been integrated into the system.

It is evident that this picture of L2 processing is based on the notion that attention plays a crucial role in SLA. It proposes that SLLs will not initially attend to certain grammatical elements in the input if they do not aid in comprehension. Parallels can be drawn between the implications of this view for learning morphosyntax and those for learning L2 speech sounds – parallels that are important for this dissertation. For example, as long as SLLs recognize the content words in spoken input, it is not necessary that they attend to the fine-grain differences in the phonetics of L1 and L2 speech sounds to extract meaning. Pedagogical techniques should be used, then, to direct students' attention to these phonetic differences. Before considering ways to implement strategies that direct students' attention to L2 speech sounds, however, attention will be turned to VanPatten's (1996, Chapter 3) Processing Instruction (see also Sanz and VanPatten, 1998; VanPatten and Cadierno, 1993a, 1993b; Wong, 2004), a pedagogical strategy based on the principles of Input Processing that aims to focus learners' attention on grammatical elements that they would otherwise not likely attend to. Furthermore, empirical research supporting and rejecting Processing Instruction will be discussed.

Based on the principles of Input Processing, "the goal of processing instruction is to alter the processing strategies that learners take to the task of comprehension and to encourage them to make better form-meaning connections than they would if left to their own devices" (VanPatten, 1996: 60). For example, knowing that SLLs would not typically process grammatical elements that carry no semantic information, or that they would typically associate the first noun in the sentence with the subject of the verb (suggested by the *First Noun Principle* of Input Processing, VanPatten, 2007: 122), Processing Instruction seeks to encourage SLLs to process L2 input in

alternate ways so that they make correct form-meaning connections. Because SLLs' goal is to extract meaning from the input, the goal of Processing Instruction can be achieved, for example, by eliminating redundant information in the input and forcing SLLs to focus on the input in ways that deviate from their natural tendencies to extract meaning. VanPatten (1996, Chapter 3) provides three components in particular for achieving this goal of Processing Instruction. One is to make SLLs aware of the grammatical structure they are to learn, similar to traditional explicit grammar explanation. The second component is to make SLLs aware of their typical processing strategies and how those strategies could mislead them in learning the particular grammar topic. The last component is to provide SLLs with *purposefully-manipulated "structured input activities"* (see VanPatten, 1996: 63) that channel their attentional strategies to help them process grammatical form in order to extract meaning. The reasoning behind Processing Instruction could be stated as follows: if SLLs will seek to extract meaning from the input, but will not typically focus on grammatical forms to do so, then manipulate the input so that meaning can only be extracted if form is attended to. This strategy should help students build stronger connections between the meaning and the grammatical form (i.e., "better form-meaning connections" VanPatten, 1996: 60).

VanPatten and Cadierno (1993b) is one of the first studies to provide support for Processing Instruction and suggests that focusing attention on grammatical forms in the input can lead to improvement not only in comprehension but, critically, also in production. In this study, Processing Instruction was compared to traditional instruction. Participants (N = 55) from a second year university-level Spanish course were divided into three groups: one receiving Processing Instruction (N = 19), one receiving traditional instruction (N = 18), and a control group receiving no instruction (N = 18). Traditional instruction included the presentation of explicit grammar explanations on the placement of direct objects and direct object pronouns in Spanish using paradigms followed by production practice. The instruction given to students in

the Processing Instruction group was designed to help students make form-meaning connections with direct objects and direct object pronouns in Spanish. In this group, students first received grammatical explanations of how direct object pronouns fit into the syntactic structure in Spanish, drawing attention especially to the fact that object pronouns can precede the subject. Students then completed practice exercises. In one type of practice exercise, students listened to or read sentences in Spanish that contained either a direct object or a direct object pronoun and responded to show that they correctly understood the sentence. They typically demonstrated their understanding either by choosing which of two pictures correctly corresponded to the sentence or by choosing which English translation of the sentence was most accurate. The second type of practice exercise exposed students to utterances or sentences and required students to respond (by clicking) that they agreed or did not agree, that the sentence was true for them or not true for them. In another activity, students read short passages after which they were presented with certain highlighted sentences in Spanish and asked what the sentences meant. Participants from both types of instruction also completed a pretest and three posttests so that learning (and sustained learning) could be measured. All of these tests included an interpretation and a production task. The interpretation task presented participants with 15 (5 fillers + 10 experimental) aural sentences and required them to choose which of two pictures corresponded to the meaning of the sentence. For example, if participants heard "Al chico lo saluda la chica," ("The girl says hi to the boy," VanPatten and Cadierno, 1993b: 49) they then saw a picture of a boy saying hi to a girl and a picture of a girl saying hi to a boy. For this example, the picture of the girl saying hi to the boy would be the correct response. In the production task, participants read incomplete sentences such as "el chico piensa en la chica y entonces…" ("the boy is thinking about the girl and then…," VanPatten and Cadierno, 1993b: 49) and were presented with two pictures that both corresponded to the picture. In this example, participants saw a picture of a boy thinking about a girl and then a picture of a boy calling a girl; so, the expected response was "he

calls her" (VanPatten and Cadierno, 1993b: 49). Results indicated that the students receiving traditional instruction improved on the production task but not on the interpretation task. This finding is somewhat surprising, but it could be attributed to the fact that the traditional instruction group practiced production more than interpretation during the instructional phrase. The group receiving Processing Instruction, on the other hand, improved on both the interpretation and the production tasks. That is, it appears that students in this group made form-meaning connections from the structured input activities, and that these form-meaning connections affected the linguistic system such that production was also improved. This finding suggests that Processing Instruction is superior to traditional instruction in classroom SLA.

VanPatten and Cadierno (1993a) replicated the findings of VanPatten and Cadierno (1993b) by obtaining the same results with a larger number of participants (129 versus 55). These studies have led to many subsequent replication studies that examined different grammatical features of Spanish. One such study was carried out by Cadierno (1995) and investigated students' learning of the preterit tense (i.e., the perfective aspect of the past tense in Spanish). To test learning of this target structure, 61 participants from a third semester university-level Spanish course were split into three groups: the traditional instruction group (N = 19), the Processing Instruction group (N = 22), and a control group receiving no instruction (N = 20). As was done in VanPatten and Cadierno (1993a, 1994b), participants in the traditional instruction group received traditional grammar explanations and output practice. The Processing Instruction group, on the other hand, focused students' attention on the past tense verb morphology as they heard or read L2 input. The organization of the instruction for the traditional instruction group was to present the verb forms for all persons in the preterit for regular verbs and then to present the forms for all persons in stem-changing verbs. In each case, after presenting the verb forms, participants practiced producing the correct forms of the preterit tense. Three types of activities were used with this type of instruction. In one, sentences were presented in the

present tense, and participants were to rewrite the sentences with the preterit form of the verb. In another, participants were to complete an incomplete sentence by providing a verb in the correct preterit form. In the last activity, participants answered questions in which they had to use forms of the preterit tense. The instruction differed for the Processing Instruction group in several ways; one way, for example, was that the presentation of the instruction was organized differently. Participants received instruction on the first and second person singular preterit forms for regular and stem-changing verbs first, followed by instruction on the third person singular preterit forms for regular and stem-changing verbs, and lastly, they received instruction on the third person plural preterit forms for all verbs. Another difference was that the Processing Instruction group was never required to produce the target form as the traditional instruction group was. Instead, participants completed activities in which they had to interpret meaning of both written and oral input and respond in ways that did not require the use of the past tense. In some of these activities, participants were presented with sentences and asked to indicate the tense or the subject of each sentence. A number of other activities were used that presented the participants with both written and oral input at both the sentential and discourse level and always required them to attend to the preterit tense to extract meaning. A pretest and three posttests were administered to all participants so that improvement could be assessed and compared across groups. Each of these tests consisted of an interpretation task and a production task. The interpretation task included the aural presentation of 20 sentences, 10 with verbs in the present tense and 10 with verbs in the past tense. Participants indicated whether each sentence was in the present or past tense, and only the 10 sentences containing verbs in the past tense were counted for analysis. For the production task, participants were presented with 5 incomplete sentences and a verb in parenthesis that they were asked to conjugate in the preterit to complete the sentence. Comparing performance across groups on these tests revealed that for the interpretation task, the Processing Instruction group improved significantly, but the traditional instruction and

the control groups did not. On the production task, both the Processing Instruction and traditional instruction groups improved significantly but the control group did not; moreover, there was no significant different between the Processing Instruction and traditional instruction groups. These results, identical to the results of VanPatten and Cadierno (1993a, 1993b), show that traditional instruction and Processing Instruction both helped students improve in their production of the preterit verb forms but only Processing Instruction helped students improve in their comprehension of them.

While Cadierno (1995) perfectly replicated the results of VanPatten and Cadierno (1993a, 1993b), some researchers tried to carry out similar studies and argue that Processing Instruction does not always lead to better learning than traditional instruction. Salaberry (1997), for example, based on results from his study that compared Processing Instruction and traditional instruction on participants' learning of the clitic pronouns in Spanish, argued that participants receiving traditional instruction improved equally as much as those receiving Processing Instruction on a comprehension task and that neither group improved on a production task. Sanz and VanPatten (1998), however, argued in response to Salaberry (1997) that he did not accurately implement Processing Instruction in his study. They indicate that too many differences were introduced into Salaberry's (1997) study to make a realistic comparison between it and the original studies supporting Processing Instruction. Yet, since 1997, other researchers have taken opposing positions to Processing Instruction as well. In studies by Collentine (1998) and Farley (2001), learners receiving both Processing Instruction and output-based instruction improved on their usage of the subjunctive. Cheng (2002) also demonstrated that Processing Instruction and output-based instruction led to comparable improvement on the use of Spanish *ser* and *estar*. Moreover, dealing with the French causative construction, Allen (2000) found that while students receiving Processing Instruction improved as much as students receiving traditional instruction on an interpretation task, students receiving traditional instruction improved significantly more on a

production task than those receiving Processing Instruction. VanPatten and Wong (2004), however, questioned the materials used in Allen's (2000) study and pointed out that she did not operationalize traditional instruction and Processing Instruction the way previous studies had done. VanPatten and Wong (2004), therefore, carried out a study of their own to compare the effects of Processing Instruction and traditional instruction on the learning of the French causative construction. They found results contradictory to those found in Allen (2000) suggesting that when comparing traditional instruction and Processing Instruction as defined and operationalized in previous studies (e.g. Cadierno, 1995; VanPatten and Cadierno, 1993a, 1993b), Processing Instruction led to more overall improvement than traditional instruction when learning the French causative construction.

As seen in this section, several studies support Processing Instruction. Moreover, while some researchers disagree with the findings of these studies, VanPatten and colleagues have often defended Processing Instruction and argued that some studies that do not support Processing Instruction (e.g. Salaberry, 1997; Allen, 2000) have failed to do so because they either failed to completely understand the nature of Processing Instruction or they did not operationalize Processing Instruction and traditional instruction in the same way that it was done in previous studies. The most controversial aspect of Processing Instruction has been the finding that attention to grammatical form in the input can lead to improved use of those forms in the output even without output practice. Sanz and VanPatten (1998) make clear, as is pointed out in other work (e.g. VanPatten, 1996), that Processing Instruction does not suggest that output practice is superfluous, unnecessary, or that it should be avoided. On the contrary, output exercises have been proposed for use with Processing Instruction (VanPatten, 1996). Nonetheless, it should be noted that studies on Input Processing have demonstrated that learners can improve in their use (i.e. production) of target structures even in the absence of explicit production practice.

It was pointed out above that Processing Instruction is based on the theory of Input Processing, which supports the notion that learners will not attend to form if it is not necessary to extract meaning. This has striking implications for helping students improve their L2 pronunciation. As mentioned above, if SLLs know what the content words are in the input, the particular phonetic characteristics of the sounds that make up that input are not important for the extraction of meaning and, thus, will not be attended to. However, while the theory of Input Processing explains, to some extent, the difficulty in learning L2 speech sounds, Processing Instruction cannot be applied to teaching pronunciation. In Processing Instruction, the goal is to require students to attend to the morphosyntax of the L2 to extract meaning and, thus, make stronger connections between morphosyntactic form and meaning. While this strategy does not address methods of focusing attention on pronunciation, the insight taken from Processing Instruction is that attention plays a crucial role in SLA. Therefore, directing students' attention to difficult aspects of the L2, including aspects of pronunciation, should help them learn those aspects. To provide further support for the idea that focusing attention on difficult aspects of the L2 enhances learning of those aspects, the next section presents another pedagogical technique that arose from discussions on the role of attention in SLA, namely, input enhancement.

1.2.2.2 Input enhancement

The growing concern with the role of attention in SLA and the growing desire to focus students' attention on grammatical forms led to a pedagogical technique known as *input enhancement* (Sharwood Smith, 1991, 1993), which refers to the strategy of enhancing (usually typographically) the forms in the input that are either target forms for a given lesson or forms that would be difficult to learn otherwise. This strategy is different from Processing Instruction in that

it does not use the extraction of meaning as a catalyst for directing attention to form, but it is motivated, nonetheless, by the goal of helping learners attend to form.

Several studies have tested the benefit of input enhancement for language learning. For example, Alanen (1995) compared the impact of italicizing target forms in the written input with the presentation of explicit rules on participants' learning of locative suffixes and consonant alternations in semi-artificial Finnish. While there was not a clear and significant difference between enhanced and unenhanced groups, analyses of think-aloud protocols revealed that participants that noticed the target forms learned more than those that did not.

Jourdenais, Ota, Stauffer, Boyson and Doughty (1995) investigated the impact of typographical enhancement on participants' performance with the preterit and imperfect in Spanish. Fourteen native English learners of Spanish participated by reading a passage in Spanish. Half of these learners received typographical enhancement with the reading passage while the other half did not. After reading the passage, participants wrote a picture-based narrative and provided think-aloud protocols. Analyses of the post-test and think-aloud protocols revealed that learners receiving input enhancement used the preterit and imperfect more often and more accurately than those not receiving input enhancement. This indicates that the learners receiving input enhancement noticed the form and that this facilitated learning.

Leow (2001) also researched the effect of typographical input enhancement by examining its impact on learning the Spanish formal imperative. Thirty-eight learners participated in this study by reading a 242-word passage. There was a group that received input enhancement while another group did not. Although there were no significant differences between the two groups on post-treatment performance, there were significant correlations in both groups between noticing (as measured via think-aloud protocols) and performance on a multiple-choice recognition test. Leow (2001) posits that the enhanced group may not have outperformed the unenhanced group because of the participants focusing so much attention on meaning rather than form. As Al-Hejin

(2004) points out, this explanation is supported by VanPatten's (1990) notion that learners have difficulty focusing on both meaning and form simultaneously. Leow (1997, 2000) report other studies that suggest that higher awareness leads to more learning.

Rosa and O'Neill (1999) also found a strong correlation between awareness and recognition, as well as intake, with syntactic structures for counterfactual conditionals. In this study, this conclusion was reached by analyzing think-aloud protocols that participants provided while working on a multiple-choice jigsaw puzzle. This study and those mentioned above provide evidence that input enhancement can lead to increased learning, arguably due to drawing students attention to the target structures.

The consistent message taken from these studies is that when students attend to aspect of the L2 being learned, their learning is enhanced. Several other researchers (Doughty, 1991; White, 1991; White, Spada, Lightbown and Ranta, 1991) have found it beneficial to focus learners' attention on specific structures as well. These studies suggest that all L2 instruction should consider techniques that direct students' attention to target structures thereby raising their awareness of those structures. However, most research on the role of attention in SLA has focused on morphology and syntax (Schmidt, 2001). Few studies, if any, have examined the potential benefits of increased attention to L2 speech sounds for learners' pronunciation. Schmidt (1993, 2001) has argued that global attention is not enough for learning, but rather that the particular structures of interest must be attended to be learned. This suggests that for SLLs to improve their pronunciation, instruction and assignments must focus their attention on L2 sounds. As Schmidt (1993, 2001) puts it, to acquire phonology, students must attend to the sound contrasts in the L2; moreover, if students are to sound more native-like, they must attend to the phonetic characteristics of the L2 sounds. This notion is supported by Logan, Taylor and Etherton's (1996) assertion that people tend to learn what they pay attention to and tend not to learn much of what they do not pay attention to.

This gives reason in the present study to focus students' attention on the L2 sounds that prove most difficult to them. By focusing their attention on specific sounds in the L2, students should attend to and be more aware of the phonetic details of these L2 sounds, and thus show greater gains in pronunciation improvement. The ways in which findings discussed here motivate particular concepts for the present study are discussed below in 1.5. Given that the majority of discussion from this point forward deals with the learning of L2 pronunciation and with differences in English and Spanish pronunciation, the next section provides detail on the primary phonetic differences between Spanish sounds that have proven difficult for native English speakers and their most comparable English counterparts.

1.3 Key differences in English and Spanish phonetics and phonology

To better understand what SLLs should attend to in order to improve their pronunciation in Spanish, the articulatory phonetics of Spanish speech sounds and how they differ from similar English speech sounds are discussed in this section. The discussion focuses specifically on the *segmental* properties of English and Spanish speech sounds. Attention is given to how SLLs perceive and reproduce sounds in Spanish. Analyses of how SLLs may perceive, reproduce, and learn to articulate speech sounds takes the Speech Learning Model (SLM: Flege, 1995, 2005) as a basis. The reader is reminded that focus is given here to native speakers of American English learning the variety of Spanish typically taught in L2 classrooms. This analysis begins with the vowels, followed by the phonemes /p, t, k, b, d, g/, and ends with the phonemes /r/, /ɾ/ and /l/.

1.3.1 The Vowels

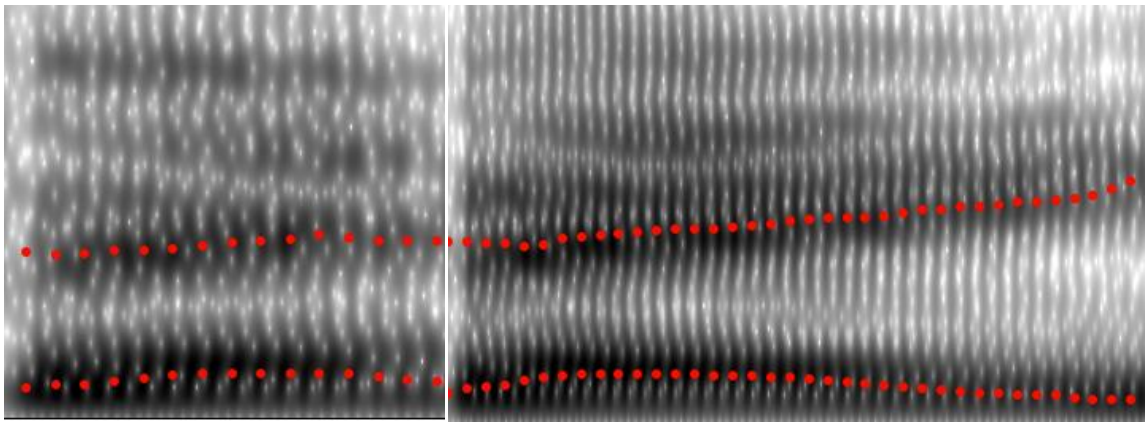
To understand discussions regarding the vowel formants as they relate to place of articulation in the vowel space (i.e. the mouth), two facts must be remembered. First, the value (and height) of the first formant (F1) is inversely related to the height of the vowel in the vowel space. For example, the high vowel /i/ has a much lower F1 value than the low vowel /a/. Second, the frontness/backness (where the vowel is articulated in the vowel space on the front-to-back dimension) of the vowel is related to the difference between F1 and the second formant (F2). A higher F2-F1 (F1 subtracted from F2) value indicates that the vowel is articulated more front (or less back) in the vowel space. For example, the front vowel /e/ has a much higher F2-F1 value than the back vowel /o/. These patterns will be seen in some of the examples below.

There are five contrastive vowels in Spanish: the low central vowel /a/, the two mid vowels /e, o/, and the two high vowels /i, u/. Depending on the dialect, these vowels may be subject to subtle allophonic variation, such as the variation in closure of the mid vowels, but these variations will not be considered, as there is no proven phonological rule that adequately accounts for these subtle variations. The prototypical articulation of each of these vowels, however, differs to some degree from the prototypical articulation of the phonetic categories of English to which a SLL maps these vowels. Therefore, each vowel will be discussed in turn.

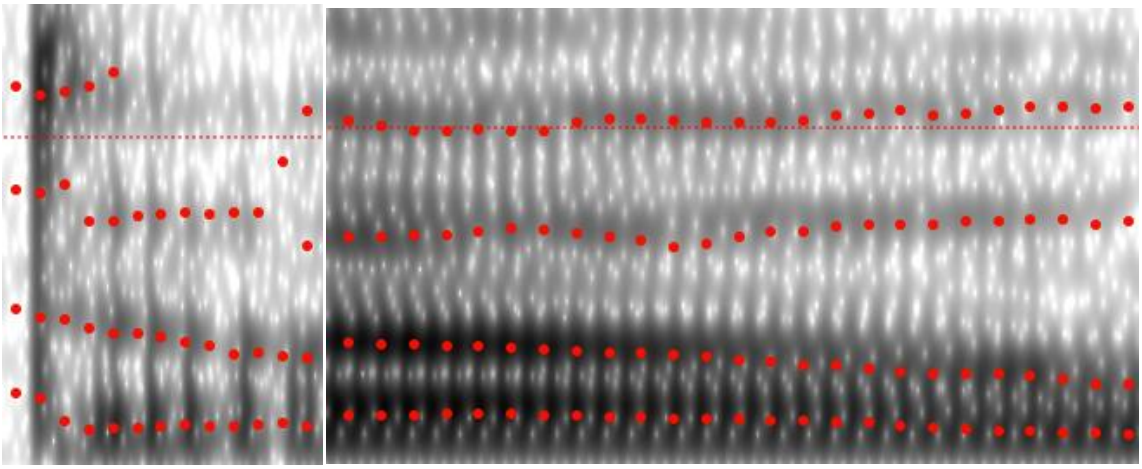
The low central vowel /a/ in Spanish is most similar to the English low back vowel /ɑ/; therefore, SLLs usually map Spanish /a/ to English /ɑ/ and reproduce the vowel inaccurately. For a SLL to accurately articulate Spanish /a/, he/she must create a new category for the Spanish low central vowel. However, the larger problem for SLLs of Spanish is that /ɑ/ is typically reduced to schwa in atonic positions. SLLs often transfer this phonological characteristic of their L1 to Spanish, a language in which /a/ is never reduced to schwa, at least in standard varieties. Therefore, one way in which SLLs of Spanish may reduce their degree of perceived accentedness

is to make sure they do not reduce /a/ to schwa in atonic syllables, thereby pronouncing /a/ as a low central vowel in all syllables.

The front mid vowel /e/ and back mid vowel /o/ in Spanish differ from their closest equivalents in English primarily in the fact that they are shorter vowels with formants maintained roughly the same throughout their duration. English /e/ and /o/ are similar to diphthongs in the sense that they glide upward throughout their articulation. This upward movement in the vowel space corresponds to a drop in the first formant throughout the articulation of the vowel (see Figure 1-1 below). Furthermore, the English vowel /e/, especially in the variety of English spoken by the participants in this study, starts out more central than Spanish /e/ and glides forward throughout its articulation. This change corresponds to an increase in F2-F1 (see Figure 1-1 below).



From Spanish “se” From English “say”



From Spanish “pleito” From English “go”

Figure 1-1. Spectrograms of English and Spanish /e/ and /o/
These spectrograms show the vowels that have been extracted from their original words. Red dots on the spectrogram track the vowel formants. English vowels are longer than their Spanish counterparts and exhibit a greater degree of movement in the vowel space, which corresponds to more movement of the vowel formants.

The /o/ vowel may undergo movement frontward or backward in the vowel space, depending on the word and the phonological environment, and perhaps even the individual. For this reason, no particular pattern can be suggested for frontward or backward movement for the /o/ vowel. These diphthongized vowels in English are often transcribed phonetically as [e^{j}] and [o^{w}], as opposed to Spanish [e] and [o]. SLLs of Spanish often pronounce the Spanish mid vowels with a foreign accent by diphthongizing them similarly to the English mid vowels. To articulate the Spanish vowels accurately, SLLs must create new categories for them in Spanish, in which they articulate shorter pure vowels that do not exhibit an upward off-glide, or possible movement forward or backward.

The high vowels /i/ and /u/ in Spanish also exhibit differences from their closest English counterparts. The Spanish back vowel is articulated further back in the vowel space than the English counterpart. This difference correlates with a higher F2 for English /u/ than for the Spanish vowel. When English speakers do not articulate /u/ in Spanish far enough back in the

vowel space, the articulation will likely be perceived as a non-native production of the vowel. The front vowel /i/ in Spanish does not compete for space in the vowel space with another high front vowel, such as /ɪ/, so acceptable places of articulation of Spanish /i/ fall into a greater range in the vowel space than English /i/. English /i/ on the other hand is in fact differentiated from /ɪ/, so the range of acceptable places of articulation within the vowel space is restricted (see Figure 1-2 below).

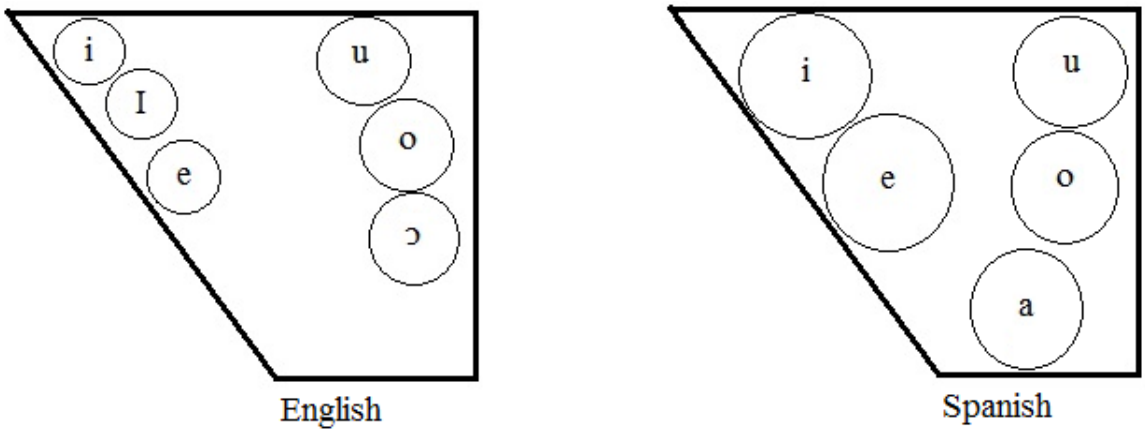


Figure 1-2. Representations of English and Spanish vowel spaces.
The representations shown are for illustrative purposes only: the representation of the English vowel space does not include all vowels and the representations for both languages are not based on concrete formant values and are not meant to be precise. Circles in the vowel spaces represent vowel categories with the idea that any vowel articulation falling within a circle would be considered an example of the vowel shown in the circle. These representations illustrate that the Spanish vowel space has fewer vowels and thus the area within the vowel space that could be categorized as a particular vowel is greater than for English counterparts.

For this reason, Spanish /i/ may be articulated as a more lax vowel than its English counterpart, or possibly as a more tense vowel than English /i/, depending on dialect. Given these differences in English and Spanish /u/ and /i/, an SLL must create new categories for their Spanish /i/ and /u/ and avoid pronouncing them identically to the English counterparts to articulate these vowels accurately.

1.3.2 The phonemes /p, t, k/ and /b, d, g/

In environments where all six of these phonemes are pronounced as plosives, there is a noticeable difference in the voice onset time (VOT) of the Spanish consonants and their English counterparts. Voicing, or pulsing at the glottis, begins several milliseconds before the release of the consonants /b/, /d/ and /g/ in Spanish. These same consonants in English are released around the same time that voicing begins, if not a few milliseconds before. The stops /p/, /t/, and /k/, on the other hand, are released approximately the same time that voicing begins in Spanish (akin to *voiced* consonants in English), while in English, in stressed simple onset position, voicing begins several milliseconds after their release. Figure 2-3 below illustrates this distinction.

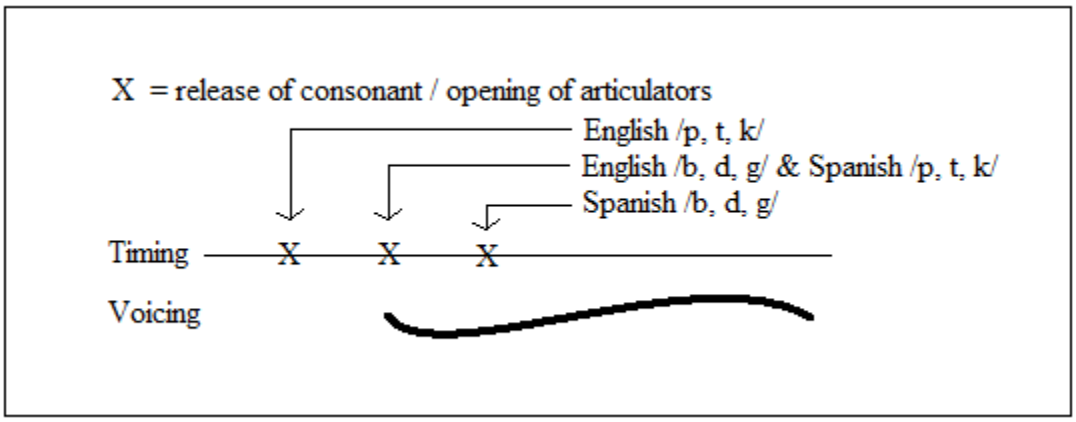


Figure 1-3. The VOT of plosives in Spanish and English.
The measurements of timing are not meant to be taken as exact comparisons. This comparison shows that the use of English /p, t, k/ in Spanish should sound odd and foreign, and that the use of English /b, d, g/ in Spanish is likely to be heard as similar to Spanish /p, t, k/.

The period of time from the release of English voiceless plosives to the onset of glottal pulsing is referred to as aspiration. English voiceless stops are considered to be aspirated when they are the simple onset of a stressed syllable, because the period of time that elapses between the release of the consonant and the onset of voicing is large relative to non-aspirated stops, in which occlusion

is opened around the same time voicing begins. SLLs must therefore create new categories for Spanish /p/, /t/ and /k/ that include earlier onset of voicing than their categories for English.

Another problem that the phonemes /b/, /d/ and /g/ present for SLLs of Spanish is that allophonic variations of these phonemes in Spanish are realized as sounds that do not exist in English. In Spanish, when these phonemes do not follow a pause or a nasal, or a lateral in the case of /d/, they are not articulated as stops, but rather as the fricatives (or approximants) [β], [ð] and [ɣ] respectively (e.g. [am.bos] *ambos* "both" but [lo.βos] *lobos* "wolves," [an.da] *anda* "go" but [a.ða] *hada* "fairy," and [aŋ.gus.tja] *angustia* "anguish" but [a.ɣwa] *agua* "water"). The orthographic overlap of *b, d* and *g* between the two languages facilitates the mapping of these approximants to the categories for /b/, /d/ and /g/ in English. This leads to the reproduction of the Spanish fricatives as stops (i.e. [b, d, g]; e.g. *hago* *[a.go], *abogado* *[a.bo.ga.do]). Therefore, to accurately articulate these consonants, SLLs of Spanish must create new categories for Spanish /b, d, g/ that incorporate this phonological difference and learn to articulate [β, ð, ɣ] rather than [b, d, g] in the appropriate contexts.

1.3.3 The phonemes /ɾ/, /r/ and /l/

The rhotics in Spanish, /ɾ/ and /r/, are stereotypically difficult for SLLs. They differ greatly from the English rhotic, a retroflex or postalveolar approximant /ɻ/ or /ɹ/. The tap /ɾ/ is articulated with a quick tap of the tongue against the alveolar ridge. This is phonetically most similar to the English allophone [ɾ] for /d/ and /t/ when these phonemes are intervocalic and the onset of an atonic syllable (e.g. paddle [ˈpæ.ɾɫ], butter [ˈbʌ.ɾɚ]). Therefore, to articulate this Spanish rhotic authentically, SLLs must create a new category and extend the [ɾ] allophone of phonemes they have in English to the prototype of this new category.

The multiple trill /r/ is articulated with enough air pressure to flap the tip of the tongue against the alveolar ridge multiple times. This articulation is widely recognized for its difficulty for people whose native language does not include this sound. It is not similar to any English sound, so SLLs should discern the differences in articulation between this sound and any English sound. While the Speech Learning Model (Flege, 1995, 2005) predicts that this scenario leads to new category formation and eventually to correct production, many SLLs never learn to authentically produce this Spanish rhotic. This is likely due more to a lack of motor control than to a lack of discerning the articulatory features of the sound. Therefore, SLLs of Spanish must create a new category for Spanish /r/, but to articulate it accurately, they must also practice and attempt to produce this rhotic as a multiple trill rather than as an approximant.

English /l/ has two allophones, alveolar [l] and velar [ɫ], which vary depending on their position in the syllable. Specifically, English /l/ is velarized in coda position. This is not the case for Spanish /l/, which only has alveolar [l]. This presents problems for SLLs of Spanish, as they may articulate a Spanish word like *tal* as if it were the English word *tall* [tɑɫ] rather than the accurate [tal]. Therefore, a SLL of Spanish must learn to avoid the production of [ɫ] and to produce alveolar [l] for the phoneme /l/ in all phonological environments in Spanish.

The differences in English and Spanish sounds discussed above have received the most attention in the literature and in previous studies. At the segmental level, these differences are arguably the largest contributors to SLLs' foreign accentedness. As discussed more in chapter 2, the study presented in this dissertation focuses on students' improvement in the production of the mid vowels /e, o/ specifically. Since this study attempts to improve students' pronunciation of these sounds via intervention in the classroom, the next section presents a discussion of evidence from the literature that instructional intervention can, in fact, lead to improvement in pronunciation. It is also argued that pronunciation improvement in previous studies is primarily due to students' increased attention to L2 speech sounds.

1.4 Pronunciation improvement in the L2 classroom

Past studies have investigated the effect of phonetics and phonology instruction in the classroom on students' pronunciation. While Suter (1976) reported that the amount of formal pronunciation training in the classroom did not affect SLLs' accuracy in the production of English sounds, several other studies have suggested that pronunciation instruction does help students improve their production of L2 sounds (Murakawa, 1981; Neufeld and Schneiderman, 1980; Derwing et al., 1998; Elliott 1995b, 1997; Lord, 2005). Three studies in particular will be discussed below in turn.

Elliott (1997) sought to investigate the role of phonetic and phonological instruction in the L2 classroom on students' improvement in pronunciation of the following 19 sounds: [r, ɾ, β, ð, ɣ, b, p, t, k, d, ñ, z (voicing of /s/), m (from /n/ as in [um.pa.to] *un pato* "a duck"), g, a, e, i, o, u]. Sixty-six students from three sections of an intermediate Spanish course participated. Two of the three sections comprised the experimental group (N = 43), and the third section served as a control group (N = 23). Students in the experimental group were given consistent instruction on and practice with Spanish pronunciation. While the control group did not receive this pronunciation instruction and practice, all other aspects of the class were identical between the groups. In order to judge students' improvement in pronunciation, they produced words and sentences at the beginning and end of the semester (i.e. in a pretest-posttest design). In these productions, students were asked to mimic words (i.e. repeat words they heard aloud), mimic sentences, read words, and speak spontaneously to describe one of two pictures. Three judges (the experimenter, who possessed native or near-native Spanish pronunciation, a Chilean doctoral student, and an American English speaker who possessed native or near-native Spanish pronunciation) later judged each of these productions as inaccurate, accurate, or partially accurate. Improvement was assessed by submitting judgments on the pretest and posttest

productions for both groups to an analysis of covariance (ANCOVA). Based on the results of this analysis, students improved after the pronunciation instruction and practice they received throughout the semester. This improvement was more robust when reading words than when mimicking them. In addition, students improved more when mimicking sentences than when mimicking words in isolation, and their improvement on spontaneous speech production approached significance. When considering the allophones individually, the author found that the instruction led to improvement specifically in the production of the sounds [r, p, ɾ, d, β, t, u, k, o, ñ]. While improvement was not significant for all 19 sounds investigated, the results of this study suggest that phonetic and phonological instruction is beneficial for helping adult SLLs improve their L2 pronunciation.

With evidence that pronunciation instruction in the L2 classroom can prove beneficial, Derwing and Munro (Derwing and Munro, 1997; Derwing, Munro, Wiebe, 1997, 1998; Munro and Derwing, 1994, 1995a, 1995b, 1999) have investigated the best ways to approach pronunciation instruction with SLLs. Derwing et al. (1998) compared two methods of pronunciation instruction given to a total of 48 adult learners of English as a second language (ESL) coming from various L1 backgrounds and residing in Canada. The participants were divided into three groups: a segmental group (N = 16) that received instruction on the segmental properties of English sounds, a global group (N = 16) that received instruction on suprasegmental properties of English speech, such as stress, intonation and rhythm, and a "no pronunciation-specific" group (N = 16) that served as a control group. While the segmental group received instruction on the articulatory phonetics of specific speech sounds, the instruction given to the global group focused on pronunciation at the discourse level; that is, students received instruction on how English speech generally flows. Instruction given to the control group did not explicitly attempt to avoid information regarding pronunciation, but it was given without a particular emphasis on pronunciation. To assess improvement in pronunciation over the study, all

participants were recorded reading simple sentences and then speaking extemporaneously (by narrating a picture story) at the beginning and end of the semester (i.e., a pretest-posttest design). Later, for the simple sentences, 48 native Canadian English listeners rated each sentence on a 9-point scale on its comprehensibility (i.e., how easy it is to understand) and on its accentedness (i.e., how accented it sounds). For the extemporaneous speech, 6 "experienced women ESL teachers" (Derwing et al., 1998: 404) rated segments of speech on a 9-point scale on its comprehensibility, accentedness, and fluency. Improvement was determined by comparing ratings for pretest utterances with those for posttest utterances. Results indicated that when reading simple sentences aloud, both the segmental and the global groups improved their accentedness and comprehensibility, while the control group did not improve either. Moreover, the segmental group improved its accentedness significantly more than the global group, suggesting that at the sentence level, segmental instruction may be better. On the other hand, when producing extemporaneous speech, the segmental group did not improve in terms of accentedness, comprehensibility, or fluency. The global group in this condition exhibited significant improvement in their comprehensibility and fluency, although they did not improve significantly in their accentedness ratings.

While the results of Derwing et al. (1998) revealed that learners did not improve their accentedness on extemporaneous speech, this may be because more accurate articulatory control in extemporaneous speech takes more time than one semester to achieve. Overall, however, these results contribute most importantly to findings that pronunciation instruction can lead to students' improvement in pronunciation (at least at some level) over the course of a semester in an L2 classroom. It is possible that instruction on L2 phonetics leads to the students' improvement in pronunciation because it leads them to attend to the aspects of language relevant for pronunciation improvement; namely, the articulatory characteristics of segments or the suprasegmental features of the language. If attention is the key to improvement in these studies,

and not the phonetic instruction itself, it should be possible to help students improve their pronunciation without phonetic instruction in particular. The following study supports this notion.

McCandless and Winitz (1986) investigated the impact of increased auditory training in the classroom on German students' improvement in pronunciation. These authors sought to find whether students in a comprehension-intensive German class would improve their accent in the L2 more than students in a traditional German class. Participants in this study included students from a comprehension-intensive German class, students from a traditional German translation class, psychology students with no exposure to German, and native German speakers. For the comprehension-intensive German class, emphasis was given to activities in class that trained students on their comprehension of spoken German. The use of reading and writing was deemphasized in this course until the end. There was not, however, any strict production or pronunciation training given. The students in the translation class learned German throughout the semester in a way that did not stress the auditory comprehension. The native German speakers provided a baseline and the psychology students were used as a control group. At the end of the semester, all participants heard and repeated 5 German sentences read by native German speakers. These repetitions were then judged by native German speakers on how accented they sounded. Results of these judgments by native speakers indicate that the native speakers of German were given the best marks for accentedness. The second best group was the group of students from the class in which auditory comprehension was emphasized. The students from the traditional class received better marks than the psychology students, but worse marks than the students in the comprehension-intensive group. These results suggest that emphasizing auditory comprehension and giving students intensive auditory input helps them increase their pronunciation in the L2. Importantly for the study in this dissertation, these results also suggest that practice with L2 production is not necessary for improvement in L2 pronunciation. This is

arguably because whether students receive production practice or not, the key is that they attend to pronunciation differences in the L1 and L2. This study supports the notion that phonetic instruction itself is not the most important aspect, but rather attention, because it shows that instruction on the phonetics of speech sounds is not necessary for students to improve their production.

The three studies discussed above provide evidence that particular instructional strategies can lead to students' improvement in pronunciation. Research on Processing Instruction (discussed above in Section 1.2.2.1) suggests that when SLLs attend to the necessary aspects in the input, production practice is not mandatory for production improvement. In addition, the results from McCandless and Winitz (1986) suggest that pronunciation improvement is possible even without explicit instruction on pronunciation. Together, these studies support the notion that the improvement in pronunciation found in the studies discussed in this section is most likely due to increased attention to differences in L1 and L2 speech sounds. However, none of these studies have specifically addressed the notion of attention. Furthermore, none of them have sought to understand the ways different aspects of instruction contribute to focusing students' attention on the L2 sounds of interest. The study in this dissertation seeks to increase students' attention to pronunciation through a combination of instruction and a specially designed assignment. In the next section, attention will be turned to a discussion of how students' attention may be directed to pronunciation in the L2 classroom context.

1.5 How to increase students' attention to pronunciation

The most typical approaches to language pedagogy do not encourage students to pay attention to the phonetics of the second language. Even language curricula that implement newer pedagogical approaches, such as focusing students' attention on aspects of the language that are

difficult to learn, do not focus these efforts on pronunciation.[2] Schmidt (1993, 2001) has explicitly argued that focusing attention on sub-phonemic (phonetic) details of L2 sounds is necessary for learning or improving L2 pronunciation. This argument suggests that the lack of progress that many learners of Spanish make, as mentioned in the introduction, may be due, in fact, to the lack of attention to the details of L2 sounds in L2 classrooms. As discussed above (see 1.4), research indicates that phonetic instruction in the classroom can lead to improvement in pronunciation. This improvement in pronunciation may be due to focusing students' attention on the phonetics of the L2 speech sounds. This could suggest that phonetic instruction alone is enough to direct students' attention to the phonetic properties of L2 speech sounds, and in so doing, help them improve their pronunciation. There are three concerns with this idea, however, which this dissertation addresses. One is that these previous studies did not acknowledge the role of attention in learning and thus may have compromised the amount of attention that could have been given to L2 pronunciation. It is possible that a combination of instruction and carefully designed assignments would lead to greater pronunciation improvement than instruction alone. The second concern is that most teachers are not experts in phonetics and thus are not capable of providing students the type of instruction that was provided in the studies cited above (see Section 1.4). The final concern addressed here is that the type of instruction provided in the studies discussed above (see Section 1.4) may be too time-consuming in most classroom situations. Given that time in class is the most opportune time for students to practice communicating in a learning environment, methods of focusing students' attention on pronunciation without consuming large amounts of valuable class time will be superior to those that do consume large amounts of class time. Even in cases where teachers are not experts in

[2] An examination of the standardized syllabi used for basic Spanish language courses at several American universities reveals that pronunciation receives very little attention if any at all.

phonetics and little class time can be devoted to pronunciation improvement, perhaps simplified, basic phonetic instruction provided through supplementary materials is sufficient, when combined with carefully designed assignments, for students to notice necessary phonetic characteristics in L2 speech sounds and improve their pronunciation.

The challenge taken on by this dissertation project is to investigate how instructors can direct students' attention to phonetic details of the L2 both *effectively and efficiently*. In this sense, effectiveness refers to obtaining results that are not only positive, but maximally positive. Efficiency here refers to finding methods of instruction that take up as little time in class as possible. This is important because the priority for time spent in class should be to provide students with opportunities to practice speaking the L2. The method proposed in this study to effectively and efficiently direct students' attention to L2 pronunciation is to use a perception-oriented assignment rather than assignments that stress the more typical strategy of focusing on production. The perception-oriented assignment (see Chapter 2) in this study requires students to listen to other learners of Spanish and to provide feedback on their pronunciation. When students produce L2 speech and are corrected on their pronunciation, no part of this process requires students to attend to the phonetic details of the L2 speech sounds. On the other hand, if students have to provide feedback on the pronunciation of another SLL, they are forced to attend to the particular phonetic differences between sounds in their L1 and the L2. The next two subsections provide further discussion of issues surrounding the use of a perception-oriented assignment over production-oriented ones.

1.5.1 Zooming-in hypothesis

Elston-Güttler and Gunter (2008) describe and argue for a process of *zooming in* to one language or another for bilinguals. While there has been much debate on whether bilinguals have

only one language activated at a time or whether both languages are always activated, Elston-Güttler and Gunter (2008) argue that language activation is a dynamic process and that while an individual may have both languages activated at one moment, the individual can *zoom in* to one of the two languages over a short period of time (i.e. a period of minutes). They present results from a study, which supports their argument, in which they examined the effect of exposure to the L1 when performing in the L2. They found that when bilingual participants performed a lexical decision task (LDT) in their L2 but were either just previously exposed to their L1 or exposed to L1 phonology during the task, there was interference from the L1. This interference was not present when participants were not exposed to the L1 either prior to or during the LDT. Moreover, this interference was only found during the first half of the LDT and disappeared during the second half. This finding suggests that the participants experienced activation of both language at the beginning of the LDT but were able to *zoom in* to the L2 after a period of time.

The implication of this finding and the zooming-in hypothesis for the present study is that assignments designed to direct students' attention to L2 pronunciation should help students zoom in to the L2 as much as possible. If both languages are highly activated in a bilingual (or a SLL), it is possible that less attentional resources can be directed to the characteristics of one of the languages. If this is the case, it stands to reason that being zoomed in to the L2 more during an assignment will increase the amount of attention given to the L2, which should, in turn, lead to greater improvement. Considering this notion, the zooming-in hypothesis motivates and supports the use of the perception-based assignment tested in this study in two ways. First, it requires students to listen to the recording of another SLL speaking in Spanish several times before they provide feedback. Second, in the perception-oriented task, students must concentrate on the sounds they here and on how these sounds match or do not match characteristics of L2 pronunciation. A typical production-oriented assignment only encourages students to speak words in the L2 any way they desire; no attention to characteristics of the L2 is required. Thus,

the mere nature of a perception-oriented assignment requires students to zoom in to the L2 more than a production-oriented assignment. For more specific details of the perception-oriented assignment, see Chapter 2.

1.5.2 Less is More hypothesis

The Less is More hypothesis (Newport, 1988, 1990, 1991) was proposed about two decades ago to account for observations that adults outperform children on learning tasks in early stages while children reach a much higher ultimate attainment in the end. The Less is More hypothesis argues that adults' have a greater processing capacity than children and that this greater processing capacity allows adults to learn chunks of information faster than children. However, when ultimate attainment relies on learning fine-grained and complex structures within the chunks of information, such as the case with language learning, adults' greater processing capacity acts as a detriment to the learning process. Because children do not analyze the input they receive in a learning task as whole chunks, they are able to attend to the finer details of the input and develop a more complex understanding of the input later on.

While this seems to suggest that adults are doomed at learning tasks, the implication for SLA is that students may benefit from assignments that help them focus attention to small units at a given time. If students are given a large set of input and are expected to attend to the input as a whole, they will not know what particular, small aspects of the input to attend to. For this reason, the assignment tested in this study requires that students focus on only one set of sounds the first time they complete the assignment. Subsequent completions of the assignment ask students to focus incrementally on more and more sounds, but they are told each time to focus on one set of sounds first and then to go back and listen again for each set of sounds (see Chapter 2 for more details).

1.5.3 Summary

In summary, the study presented in this dissertation attempts to direct Spanish learners' attention to phonetic characteristics of Spanish speech sounds (and particularly to phonetic differences in English and Spanish speech sounds) both effectively and efficiently. It is expected that effectiveness will be achieved by the use of both simple instruction and an assignment specially designed to force students to attend to Spanish phonetics. The technique used is considered efficient because it involves simple phonetic instruction that takes up minimal time in class and makes use of homework assignments that can be completed outside of class. In this scenario, minimal class-time is required to teach students Spanish pronunciation and to facilitate their improvement in pronunciation. Certain considerations of the zooming-in hypothesis and the Less is More hypothesis have also been made in designing the assignment tested in this study. In order to test the effectiveness of the experimental assignment proposed here (the perception-oriented assignment), it will be compared to a more typical assignment that requires students to speak in Spanish and receive feedback on their pronunciation. This comparison will be made by providing identical instruction in two sections of the same class, while one section receives the typical assignment and the other receives the experimental assignment. For more details on the methodology, see Chapter 2.

1.6 Research questions and hypotheses

The following research questions are investigated in this dissertation:

1) Does the pronunciation assignment specifically designed to direct students' attention to L2 pronunciation result in greater, measurable gains in pronunciation compared to a more typical type of pronunciation assignment?

2) When receiving instruction on pronunciation, do learners improve their pronunciation less on words they learned early relative to new words or words they learned later?

The predictions and hypotheses for these research questions is discussed now in turn.

1) It is anticipated that an assignment that focuses students' attention on properties of L2 sounds more than usual will lead to greater improvement. This hypothesis is supported by notions that attention is necessary for learning, that increased awareness leads to more learning, and that attention to phonetic details of the L2 is necessary for pronunciation improvement (Schmidt, 1993, 2001).
2) It is expected that SLLs will have more difficulty improving their pronunciation of words they learned early. This is hypothesized because students are expected to have already established lexical entries for these words and established phonological patterns associated with them. If this hypothesis is correct, it suggests that attention to pronunciation should start early in language curricula so that students do not establish heavily accented lexical entries early on. It is, then, expected that participants will perform better on nonce words than on real words in this study (see Chapter 2 for the distinction).

In the next chapter, the methodology used to examine these questions and test these hypotheses is provided. See Chapter 3 for the results and answers to these questions, and Chapter 4 for a discussion of the implications of the results.

Chapter 2

Methodology

2.1 Introduction

As mentioned in Chapter 1, the purpose of this study is to compare the impact of a production-based and perception-based assignment on Spanish students' improvement in the pronunciation of the vowels /e/ and /o/. Two sections of a Spanish conversation course were selected to participate in the study. One section was given the production-based assignment while the other section received the perception-based assignment (see section 2.3.2 for descriptions of the assignments and section 2.2 for details on the participants). Additionally, because the study employed a between-subjects design, i.e. the two groups of participants received different assignments, it is important to verify that the students in each section were not significantly different in any individual difference measures that could contribute to their improvement in pronunciation. For this reason, each participant's Spanish proficiency (see 2.2.1), inhibitory control (see 2.2.2), and attitudes about pronunciation (see 2.2.3) were measured. To compare the two sections in their improvement in pronunciation, a pretest – treatment – posttest design was used. The treatment included the classroom instruction and the pronunciation assignments. During the pretest and posttest, participants were recorded reading single words in Spanish (see 2.5.2.3 for complete details). By carrying out acoustic analyses on the recordings (see 2.6.2), comparisons could be made between sections to determine whether one type of assignment led to greater improvement in pronunciation than the other. The remainder of this chapter discusses the methodology of the study and is organized as follows. First, the participants will be described. Second, the design of the materials will be explained. Next, details regarding the procedures used to present the materials will be given. Finally, the methods of scoring the

responses to each task will be detailed.

2.2 Participants

Participants were students from two sections of a Spanish conversation course (SPAN 110) at The Pennsylvania State University. This course is part of the intermediate language program and is designed for students that have completed the final course of the basic language program (BLP). At Penn State, the BLP consists of three courses that are four credit hours each, and the intermediate language program includes two courses: an intermediate grammar and composition course and the intermediate Spanish conversation course used in this study. The goal of the conversation course is to help students improve their conversational skills in Spanish. Students are expected to improve their pronunciation, expand their vocabulary and learn expressions commonly used in conversational Spanish. To provide students with opportunities to practice the conversational skills they learn, classes are arranged around a series of structured activities that encourage students to speak in Spanish both in small groups and to the class as a whole.

Thirty-six students, eighteen from each section, participated in the study. There were three criteria for inclusion in data analyses. First, participants had to be native speakers of English because it is assumed that non-target-like articulations of /e/ and /o/ are a result of influence from English phonology. Second, they could not have learned any other L2, because experience with additional languages could alter the way sounds in Spanish are acquired and produced. The final criterion was that participants could not have had exposure to another language during childhood that would help them learn to articulate Spanish /e/ and /o/ in a more target-like manner. To determine whether participants matched these criteria, they were asked to complete Marian, Blumenfeld, and Kaushanskaya's (2007) LEAP-Q (Language Experience and

Proficiency Questionnaire, see Appendix A). This questionnaire asks participants about their history with languages both in the classroom and in naturalistic settings. Results from the questionnaire revealed that of the 36 participants, one was a native French speaker, and five had exposure to Spanish during childhood, either through education or family. These participants were not considered for analyses. Two other participants were also excluded from analyses due to technical errors during one of the testing sessions. This left a total of 28 participants, 15 in one section and 13 in the other. The 15 students in the section receiving the production-based assignment were participants in the *production group*. The 13 students in the other section made up the participants for the *perception group*. All participants considered for analyses grew up in the United States and were exposed to English from birth. Their exposure to Spanish, on average, was limited to the classroom and occasional music.

In the production group, five participants reported having friends that spoke Spanish but said that they did not speak Spanish with these friends. One other participant reported having friends that spoke Spanish and occasionally spoke with them in Spanish. In the perception group, only one participant reported having any friends that spoke Spanish and this participant also reported occasionally speaking with that friend in Spanish. While five participants from the production group had spent time abroad ranging from one to three months (mean = 2 months), four from the perception group had spent time abroad ranging from one to four months (mean = 2.5 months). Four of the participants from the production group and six of the ones from the perception group reported majoring in Spanish or double-majoring in Spanish and another field. Participants in both groups also rated their speaking, listening and reading proficiency in Spanish on a scale from 1 to 10. In the production group, the self-reported ratings for speaking ranged from 2 to 7 with a mean of 5.26 and a median of 6. For listening, the ratings ranged from 3 to 9 with a mean of 6.33 and a median of 6; and for reading, they ranged from 4 to 9 with a mean of 6.47 and median of 6. In the perception group, the ratings for speaking ranged from 4 to 8 with a

mean of 5.92 and a median of 6. For listening, they ranged from 4 to 8 with a mean of 6.23 and a median of 7; and for reading, the range was from 5 to 10 with a mean of 7.31 and a median of 7.

2.2.1 Proficiency measures

Because comparisons between two sections are made in this study, it is important to assess whether the students from each section were comparable in their Spanish proficiency. Given that there is not a consensus on how to best measure language proficiency, converging measures were used. In this study, both a vocabulary and a grammar proficiency measure were obtained for each participant.

To measure vocabulary competence, participants were asked to complete the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983, see Appendix B) in Spanish. To measure grammatical competence, they were administered the grammar sections of a Spanish language proficiency test (see below and Appendix C). The Boston Naming Test was selected because it has been normalized to measure general vocabulary knowledge. The test does not directly test knowledge of vocabulary taught in class; rather, scores reflect participants' overall vocabulary knowledge. Similarly, the proficiency test was chosen because it does not test particular content from classroom instruction but rather assesses participants' general Spanish proficiency. Both the Boston Naming Test and the grammar sections of the Spanish language proficiency test are described in more detail below.

2.2.1.1 Boston Naming Test

The Boston Naming test was originally designed to test aphasic patients' ability to accurately name objects in their native language and was normalized for English. In this test,

participants are presented with 60 line drawings of objects (see Figure 2-1 for an example) and asked to name the object as quickly and accurately as possible. In the case of Figure 2-1, participants are expected to say "canoe."

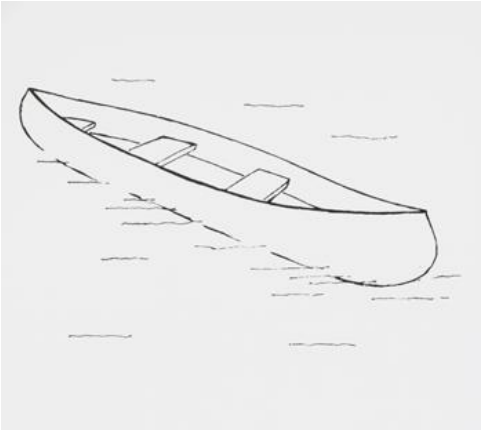


Figure 2-1. Picture of a canoe from the Boston Naming Test.

The line drawings are presented in order of increasing difficulty and include drawings of easy, high-frequency words, such as *bed*, *house*, *flower* and *hanger*, and difficult, low-frequency words like *noose*, *knocker*, *muzzle*, and *trellis*.

2.2.1.2 Spanish language grammar proficiency test

The grammatical proficiency test consisted of two grammar sections taken from a Spanish language proficiency test available on the Transparent Language website (http://www.learn-spanish-language-software.com/proftest/tlspatest.htm). Transparent Language is a company that provides software to consumers interested in learning a foreign language. The complete language proficiency test consists of two grammar sections, one vocabulary section and

one reading comprehension section. The grammar sections each contain 15 items. In the first grammar section, sentences are presented containing a blank in a random location, and correct words and phrases are provided in multiple-choice form (see Figure 2-2). Participants are asked to complete sentences with the correct word or phrase.

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12. Todas mis amigas _____ a la fiesta por Marcos.

A. han sido invitadas B. han sido invitado C. están invitado D. son invitadas

---

Figure 2-2. Number 12 taken from the first section of the grammatical competency test.

In the second grammar section, sentences are presented in which four words are underlined and participants are asked to indicate which underlined word is grammatically incorrect. An example is provided in Figure 2-3.

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5. <u>Ellos</u> <u>fueron</u> al teatro <u>los</u> <u>sábados</u>.

A. Ellos B. fueron C. los D. sábados

Figure 2-3. Number 5 taken from the second section of the proficiency test.

2.2.2 Measure of inhibitory control

Some studies have found that bilinguals usually perform better than monolinguals on tasks that require suppressing irrelevant information (see Bialystok, 2001, especially Chapter 7 and pgs. 210-218). One hypothesized reason for this advantage is that bilinguals' need to constantly suppress one language, the one irrelevant at a particular moment, during speech production leads to their increased ability to suppress irrelevant information (i.e. greater

inhibitory control). It was important to verify that the groups in this study were not significantly different in their inhibitory control, because students with greater inhibitory control may perform better on this study for one of two reasons. It is possible that participants with greater inhibitory control are able to attend more to pronunciation and suppress semantics or other distracters while learning and practicing differences in English and Spanish speech sounds throughout the semester. Another possibility is that increased inhibitory control helps participants to suppress phonological influence from their first language during the test phase of the study. In a study by Bialystok, Craik, Klein, and Viswanathan (2004), the Simon task (Simon and Ruddell, 1967; Simon and Shall, 1969) was used to measure inhibitory control because it is a simple task that can easy be completed by most participants at practically any age. Another benefit of the Simon task is that responses do not require auditory production; this is important because tasks that require participants to speak may not accurately control for the phonological component of processing during the response. For these reasons, the Simon task was used in this study to measure each participant's inhibitory control.

In the Simon task, participants see either a red or blue square on the computer screen, and are told to press the red button on the right of the keyboard if the square is red and the blue button on the left of the keyboard if the square is blue. The square appears either in the center of the computer screen, 2˚ to the left, or 2˚ to the right (see Figure 2-4). Trials in which the square appears in the center of the screen (Figure 2-4: two on the left) are control trials. In congruent conditions (Figure 2-4: middle two), the side of the screen on which the square appears coincides with the side of the keyboard on which the appropriate button is located. In this case, facilitation is expected in the processing that leads to pressing the appropriate button because the spatial cue coincides with the button that should be pressed. On these trials, reaction times are expected to decrease (i.e. participants typically react more quickly) due to the facilitation in processing, and the percentage of errors is expected to either decrease or stay the same. Critical trials are those in

which the side to which the square appears is incongruent with the side on which the corresponding button is located. On these trials, participants are expected to exhibit processing difficulties that manifest in two ways. Reaction times are expected to increase on these trials, suggesting that the processing leading to pressing the appropriate button involves resolving the conflict between the color cue and the spatial cue. An increase in the percentage of errors on incongruent trials is also expected because the conflict between the color cue and the spatial cue may not be resolved in time, in which case the spatial cue leads to an incorrect response. Examples of control, congruent and incongruent trails are shown in Figure 2-4.

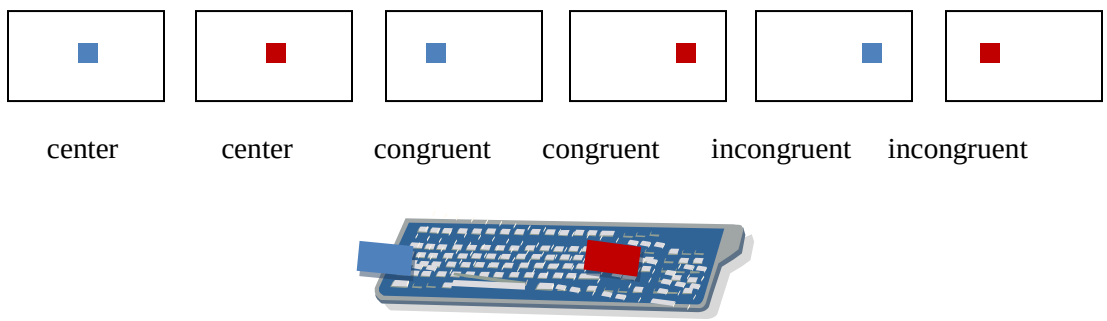


Figure 2-4. Example presentations of the Simon task.

2.2.3 Attitudes about pronunciation

It has been found that students pronounce better in the L2 when they are more concerned about their L2 pronunciation (Suter 1976, Elliott 1995a, Elliott 1995b). For this reason, each participant completed a pronunciation attitude inventory (PAI, see Appendix D), which was adapted from the PAI used in Elliott (1995b) and contained ten questions. These questions probed students' beliefs and feelings about pronunciation in the learning of a second language. For example, questions asked whether students were concerned about their pronunciation in Spanish and whether they felt that pronunciation in an L2 was more important than grammar,

communication, etc. See Table 2-1 below for participants' responses to each of the ten questions (and see Appendix D for the wording of each corresponding question).

Table 2-1. Responses from the PAI for each participant.

#	Group	Question									
		1	2	3	4	5	6	7	8	9	10
14	Production	5	5	2	5	5	5	5	3	2	2
15	Production	5	5	3	5	4	4	4	3	3	2
16	Production	5	5	2	5	4	4	3	4	2	2
17	Production	5	5	3	5	3	4	2	3	4	2
18	Production	5	4	2	5	4	3	2	3	3	2
21	Production	5	5	3	5	5	5	5	3	3	2
22	Production	5	5	4	4	4	3	5	3	3	2
23	Production	5	5	2	5	4	5	5	2	1	3
26	Production	5	5	2	5	3	4	5	4	2	2
27	Production	5	5	3	4	4	5	5	5	3	1
28	Production	5	5	4	3	3	3	4	4	3	2
30	Production	3	4	1	5	2	3	3	3	2	2
38	Production	2	4	3	4	3	4	4	4	3	2
43	Production	5	5	3	5	4	3	5	4	1	2
46	Production	5	4	2	5	4	4	3	5	3	1
Avg.	Production	4.66	4.73	2.60	4.66	3.73	3.93	4.00	3.53	2.53	1.93
11	Perception	5	5	3	5	4	4	5	3	4	5

12	Perception	5	5	3	5	4	4	5	3	3	2
19	Perception	5	5	2	5	3	4	4	4	3	2
20	Perception	4	4	3	4	3	4	4	4	3	2
25	Perception	5	5	1	1	1	5	1	4	1	1
29	Perception	5	5	1	5	3	4	3	4	2	1
32	Perception	5	5	3	4	4	4	4	5	4	1
33	Perception	4	4	3	3	5	4	3	3	2	2
35	Perception	5	5	3	5	3	4	5	5	4	2
37	Perception	5	5	2	5	5	5	4	4	3	4
40	Perception	4	4	2	5	3	4	4	5	2	2
42	Perception	5	5	4	3	4	4	5	3	3	4
44	Perception	5	5	2	4	4	4	3	4	3	1
Avg.	Perception	4.76	4.76	2.46	4.15	3.53	4.15	3.84	3.92	2.84	2.23

Note: Responses were given on a five-point scale. Questions are numbered across the top and divided by columns. See Appendix D for the wording of each question.

As can be seen from Table 2-1, average responses to all questions were comparable between the two groups. T-tests performed for each question revealed that the two groups did not differ significantly on any of the questions. Specifically, participants in both groups desired to improve their pronunciation (question 1), thought pronunciation was important (question 2), and believed they could capable of improving their pronunciation (question 4). There was a slight tendency to agree that more emphasis should be given to pronunciation in class (question 5), but there was also a slight tendency to agree that general communication was more important than pronunciation (question 8). Participants' responses to question 9, regarding the importance of pronunciation compared to the importance of grammar and vocabulary, for both groups, revealed

a general feeling that all of these aspects are just as important as the others, but that none is more important than another. Lastly, contrary to my belief and hypothesis prior to the study, participants in both groups tended to report that they had little fear, if any, of trying to speak with a target-like accent in class (question 10). Taken as a whole, the results from the PAI suggest that the students in both groups had an open mind and were ready to try to improve their pronunciation in Spanish. They believed pronunciation was important, and they believed they could improve their pronunciation with instruction and practice.

2.3 Treatment phase

The treatment phase consisted of the classroom instruction, which was identical for both sections, and the pronunciation assignments, which differed between sections. These two aspects of the treatment phase are discussed below.

2.3.1 Classroom instruction

Both sections of the Spanish conversation course were taught by the experimenter to ensure that the instruction in both sections was identical. One aspect of the course that is of particular interest is that focus is given to pronunciation improvement. Instruction on articulatory phonetics and simple phonological processes in Spanish was provided in class to help students improve their pronunciation. While details typical of a course in Spanish phonetics and phonology were avoided, teaching the notion that articulations are conditioned by phonological environments was necessary to explain the stop-fricative alternation of /b, d, g/ in Spanish (described in Chapter 2).

Pronunciation topics were divided into units (see Table 2-2 below) and were presented at

the beginning of each week, starting in week 6 (the regular semester is 16 weeks long). In the remainder of each week, topics were reviewed to remind students of the details of the pronunciation topic being covered. Once all topics had been taught, reviews and reminders of all topics were given weekly throughout the rest of the semester.

Table 2-2. Division of pronunciation units, the week they were taught, and topics covered.

Unit	Week	Topic
1	6	All vowels (particular attention given to /a, e, o/)
2	7	Difference in English and Spanish VOT for /p, t, k/
3	8	Spirantization of /b, d, g/ in Spanish
4	9	English velarization of /l/ & the articulation of Spanish [ɾ]
5	10	/t/ and /d/ in atonic onset position & voicing quality of *s* and *z*

Instruction on articulatory phonetics started in week 6, soon after the completion of the pretest in week 5. Because the focus of the study is to measure participants' improvement in pronunciation of the vowels /e/ and /o/, the first unit of phonetic instruction included the vowels. In this unit, participants were taught that /e/ and /o/ are diphthongized and /a/ is reduced to schwa in unstressed syllables in English but that in Spanish, /e/ and /o/ are always monophthongs and /a/ is never reduced (for this and other units, see Chapter 1 for a contrastive analysis of English and Spanish sounds). In unit two, students were taught that /p, t, k/ are *aspirated* in stressed syllables in English and were instructed not to aspirate these consonants in Spanish. Unit three was designed to help students become aware that /b, d, g/ are not articulated as stops in many

phonological contexts in Spanish; students were asked to practice articulating these consonants as fricatives or approximants in the appropriate contexts. Unit four focused on the pronunciation of /l/ in coda position and on the articulation of [ɾ]. Instruction included information about the velarization of /l/ in coda position in English and students were told to avoid this when speaking Spanish. It was also explained to them that a single *r* in Spanish is pronounced similarly to the *tt* in *butter* for American English speakers, and they were given examples to practice. Lastly, in unit five, students were taught that in American English, *t* and *d* are pronounced similarly to Spanish *r* when they begin an unstressed syllable, and they were instructed not to transfer this characteristic of American English phonology to their Spanish. They were also taught in the last unit that *s* between vowels and *z* are never pronounced like the *z* in English, and they were told to be aware of this and to be careful not to produce [z] in Spanish. Students were frequently reminded to implement what they were learning about Spanish phonetics and phonology into their own Spanish and were required to consider these topics as they completed the pronunciation assignments throughout the semester.

2.3.2 Pronunciation assignments

Each section was assigned a pronunciation assignment five times throughout the semester. One section was given a production-based assignment while the other was given a perception-based assignment. A description of each pronunciation assignment follows.

2.3.2.1 Production-based assignment

The production-based assignment was the same assignment designed by the course supervisor to be used in all sections of the conversation course from which two sections

participated in this study. One way to think of this is that while the perception-based assignment (see below) deviated from the typical design of the course, the production-based assignment exemplified the typical pronunciation for the course. For this assignment, students recorded themselves five times during the semester and received individual feedback concerning their pronunciation each time. To record themselves, they read from a script in the textbook. The instructor provided feedback by returning printouts of this script to each student with comments detailing pronunciation errors. Sounds that were non-target-like at the segmental level were highlighted and students were reminded of the information delivered in class. Feedback was given each time only on the sounds that had been taught up to that point in the semester. For example, in the first assignment, students received feedback only on their articulation of the vowels, but in the second, they received feedback on their articulation of the vowels and /p, t, k/. See Chapter 3 for an example of the feedback provided. Students also received a grade on this assignment based on how well their pronunciation of the segments taught to that point approached target-like norms.

2.3.2.2 Perception-based assignment

Students that received the perception-based assignment listened to recordings of students from the other section of the conversation course. Students in the other section whose recordings were used consented to the use of their recording for the purposes of this study. For each recording, students were asked to inform the instructor if they knew the speaker in the recording. None of them said that they knew the speaker in any of the recordings. Students were given a copy of the script from which each speaker read and were instructed to provide feedback on the script regarding the pronunciation in the recording. They were told to specifically point out non-target-like articulations and to explain why each deviant pronunciation was non-target-like.

These students were also instructed to focus specifically on all the sounds that had been covered in class to that point. For example, in the first assignment, they focused on the speaker's pronunciation of the vowels only, but on the second assignment, they also focused on the pronunciation of /p, t, k/. An example of the feedback typically provided can be found in Chapter 3. Students' grades on this assignment were based on their ability to accurately indicate non-target-like articulations and to justify their assessment.

2.4 Pretest/Posttest experimental materials

To elicit participants' productions of the Spanish vowels /e/ and /o/, a list of words containing these vowels was created. To test whether learners of Spanish exhibit better or worse pronunciation on new or unknown words relative to words learned early, both real and nonce words were used. The nonce words were created following the phonotactic rules of Spanish so they would be perceived as possible words of the language (e.g. *trogosa*, *adaga*, *gredona*, *latiba*). The list contained 22 experimental words, 12 real and 10 nonce words. There were 32 total occurrences of the mid vowels within these words, 16 of /e/ and 16 of /o/. For the 16 occurrences of each vowel, half were in real words and half were in nonce words. This design of experimental materials yielded the groups shown in Table 2-3 below.

Table 2-3. Examples of each type of vowel.

Vowel	Word type	Examples
/e/	real	*tristeza* "sadness", *bastante* "enough"
	nonce	*seneza, fogote*
/o/	real	*coche* "car", *alto* "tall"
	nonce	*trogosa, busado*

In addition, 127 filler words, 92 of which were real and 35 of which were nonce words, were added to the 22 experimental words. The nonce filler words consisted of the same characteristics as the nonce experimental words described above. The real filler words were chosen with the expectation that students had seen them in class; however, they covered a range such that some words were expected to have been learned early and some were expected to be less known or remembered. With nonce words included, the entire stimulus set was expected to represent a range of words known very well to words never seen before. All experimental real words, however, were expected to have been learned early and to be well known, and the filler words were not considered for analysis in this study. See Appendix E for the complete stimulus set, which contained 149 words (127 filler + 22 experimental).

2.5 Experimental procedure

Participants completed the LEAP-Q, the PAI and the grammar proficiency test before the testing phrase. The testing phase consisted of the pretest and posttest. Each test session was used to elicit participants' pronunciation of the vowels /e/ and /o/. The Simon task, the Boston Naming

Test, and a translation verification task were also administered during the testing sessions. The procedure used to administer each task is explained below.

2.5.1 Prior to the pretest session

Participants completed the LEAP-Q, the PAI and the Spanish grammar proficiency test before performing the pretest or receiving initial instruction regarding pronunciation. The LEAP-Q and PAI were both provided to the participants online via ANGEL, the course management system used by Penn State. Both materials were made available to the participants during the third week of the semester, and participants completed and submitted them by the fifth week. The Spanish grammar proficiency test was administered in class in the form of a quiz. It was explained to students that the test would assess their grammar proficiency but that it would not affect their grade. Participants were told to finish as quickly as possible, but there was no time limit. All participants completed the test within fifteen minutes.

2.5.2 Pretest session

Participants came to the testing laboratory during the fifth week of the semester to complete the pretest session. They first signed the informed consent form for the study. Next, they completed the Simon task, the Boston Naming Test, and the pronunciation elicitation task in front of a computer in a sound attenuating room. Lastly, they completed the translation verification task. They completed all tasks in succession but were told they could take a break between tasks. No participant took a break at any point during either testing session. They were also instructed to stop after each task and inform the experimenter that they were ready for the next task. The procedures used to administer each of these tasks are described below.

2.5.2.1 Simon Task

The Simon task was administered using the E-Prime software (Psychology Software Tools, Inc.). Participants sat at a comfortable distance from the computer. They placed their right index finger on a button marked with red tape on the right side of the keyboard and their left index finger on a button marked with blue tape on the left side of the keyboard. The experimenter explained the task to participants before they started. The task began with a practice block of 24 trials followed by three experimental blocks that contained 42 trials each. Trials were presented randomly within each block. To encourage accuracy, when participants pressed the incorrect button, *ERROR* appeared on the screen for 1500 milliseconds. The reaction time and accuracy of each trial were recorded for later data analysis.

2.5.2.2 Boston Naming Test

The Boston Naming Test was administered using the E-Prime software. The serial response button box and microphone that accompany the E-Prime software were used to collect reaction times for all participants' responses and to advance to the next stimulus item following participants' voice response. The microphone was placed under the computer monitor on the desk in front of the participant. A Marantz PMD660 professional portable solid state recorder and an Audio Technica ATM75 bidirectional microphone were also used to digitally record participants' answers. Participants sat at the computer and wore or held the Audio Technica microphone. As line drawings appeared on the computer screen, participants named them in Spanish. Each drawing remained visible until the participant began to speak or for a maximum of five seconds. Once the participant began to name a drawing, or after five seconds, that drawing disappeared, and the next one appeared after a delay of one second. For example, when a picture

of a unicorn appeared, participants were expected to say *unicornio* ("unicorn"), and one second later, the next drawing would be presented. Participants said *no sé* ("I do not know") if they did not know the name of the object pictured. They were also asked not to make noises between naming the drawings because this would trigger the presentation of the following drawing.

2.5.2.3 Pronunciation elicitation task

The pronunciation elicitation task was created using the E-Prime software. Words from the experimental materials (see section 2.4 above) were presented one by one in random order on a computer screen. As with the Boston Naming Test, the serial response button box and microphone that accompany E-Prime were used so that the presentation of the next word would be triggered by speech. The Marantz PMD660 recorder and Audio Technica ATM75 microphone were also used to digitally record participants' pronunciation of the stimulus words for later acoustic analysis. The instructions were explained to the participants before they began the task, and they were reminded not to make any noise between words. There was no time limit for reading aloud the word presented, so words remained on the screen until the participant started speaking.

2.5.2.4 Translation verification task

Participants left the computer and sat at a desk to complete the translation verification task. In this task, participants were given a sheet of paper that contained the 149 stimulus words and were instructed to translate each word into Spanish but to skip the words that they did not know. Given that 45 words were nonce words, participants were expected to skip those 45 words minimally. The words of interest in the task were the 22 experimental words. After translating as

many words as they could, participants returned the paper to the experimenter and left the laboratory.

2.5.3 Posttest session

The posttest session took place at the end of the semester in the fifteenth week of the course. This session was carried out identically to the pretest session described above, with the exception that the Simon task was not included. Participants came to the laboratory and completed the Boston Naming Test, the pronunciation elicitation task, and the translation verification task following the same procedures described for the pretest.

2.6 Scoring

The techniques used to score the Boston Naming Test, the Spanish grammar proficiency test and the Simon task are discussed in this section. The method used to evaluate participants' pronunciation of the vowels /e/ and /o/ are also explained here.

2.6.1 Proficiency tests

For the two proficiency tests, scores were calculated on the basis of providing one point for every correct answer. On the Boston Naming Test, participants received 1 point for each correctly named line drawing. There were 60 line drawings so 60 was the maximum possible score. If two or more responses were acceptable for a picture, either or any of them would have been given a point, but all correct responses given in this study were the same word for each picture. On the Spanish grammar proficiency test, the highest attainable score was 30 because

there were 15 questions on each of the two sections, and participants were awarded 1 point for each correctly answered question.

2.6.2 Simon task

Scoring for the Simon task involved several steps. Incorrect trials were eliminated, as were trials that followed error trials (this was done because participants sometimes hesitate or are surprised when they see the *ERROR* message). Trials with a reaction time of less than 200 milliseconds or more than 1500 milliseconds were also eliminated. Responses given faster than 200 milliseconds were eliminated because these trials likely indicate that the participant responded either accidentally or without processing the spatial and color cues on the screen. Responses given after 1500 milliseconds were eliminated because they indicate that the participant either did not focus on the trial or refrained from pressing any button at the moment of initially processing the spatial and color cues.

For each participant, the average reaction time on congruent trials was subtracted from the average reaction time on incongruent trials. Because the difference in reaction time between congruent and incongruent trials indicates the degree to which a participant is affected by suppressing irrelevant information, this difference is referred to as the *Simon effect*. Smaller effect scores imply greater control. Higher effect scores indicate that more processing time is needed to resolve the conflict between the spatial cue and the color cue, suggesting less control in the inhibition of irrelevant information.

2.6.3 Measuring the vowels /e/ and /o/

As mentioned in Chapter 1, diphthongization of the vowels /e/ and /o/ is a characteristic

of English phonology. Consequently, the first two formants were measured for each articulation of these vowels to assess students' diphthongization of the vowels. It is expected that participants who articulate the mid vowels in a more target-like manner will exhibit less diphthongization of the vowels. For each /o/ vowel, F1 was measured near the beginning of the vowel (*time one*: T1) and again near the end (*time two*: T2), and for /e/, both F1 and F2 were measured at T1 and T2. To avoid transitional effects between the vowel and neighboring consonants, the exact points for T1 and T2 were determined on a case by case basis. However, as a general rule, formants at T1 were measured 30% into the vowel, and formants at T2 were measured 20% from the end of the vowel (see Figure 2-5 for an example).

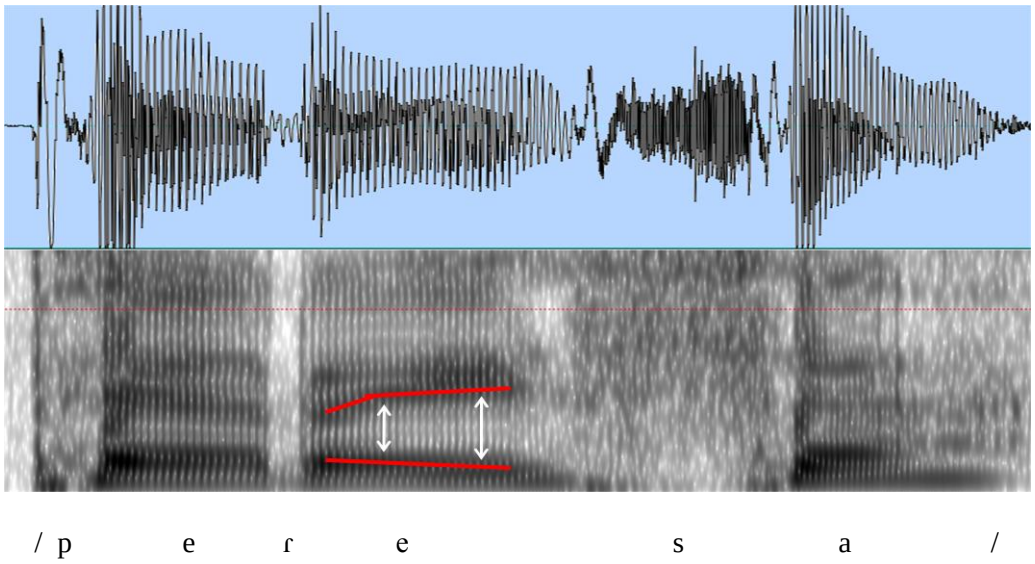


Figure 2-5. Sound wave and spectrogram for the word *pereza*.
The sound wave and spectrogram of the word *pereza* "laziness" as pronounced by a participant in the study is shown. The red lines indicate the location and movement of the formants, and the white arrows indicate T1 and T2. T1 is indicated by the leftmost arrow and T2 by the rightmost arrow.

F1 was measured for the /o/ vowel because F1 is expected to decrease from T1 to T2 if the vowel is diphthongized due to influence from English phonology (see Chapter1). Both F1

and F2 were measured for the /e/ vowel because a diphthongized pronunciation of /e/ is expected to exhibit a divergence of F1 and F2 (see Chapter 1). That is, F2 minus F1 (F2-F1) is expected to increase from T1 to T2. Diphthongization was quantified by measuring the change in the formants from T1 to T2 for each target vowel. To quantify the diphthongization of /o/, the following formula was used: F1(T1) – F1(T2). Similarly, the formula used to quantify diphthongization of /e/ was the following: F2-F1(T2) – F2-F1(T1).

In the next chapter, the results of the study will be shown and discussed.

Chapter 3

Results

3.1 Introduction

In this chapter, I begin by presenting the results and statistical analyses that were conducted to address the research questions posted at the end of Chapter 1 and repeated below in 3.2. Because the number of participants in each group of this study is relatively small, in 3.3, non-parametric statistical analyses are presented to verify conclusions drawn from the analyses in 3.2. In 3.4, analyses of the feedback provided by the participants in the perception group are provided to verify that the assignments were completed the way they were expected to be. Lastly, the chapter is summarized in 3.5.

3.2 Research questions

In this section, each of the four research questions is considered in turn. For each one, results from the study that are necessary to answer the question are provided.

3.2.1 Research question 1

Does the pronunciation assignment specifically designed to direct students' attention to L2 pronunciation result in greater, measurable gains in pronunciation compared to a more typical type of pronunciation assignment?

Given past research findings suggesting that increased attention to different aspects of L2 grammar leads to improvement in the comprehension and production of those aspects, it is

predicted that the answer to this question is yes (see Chapter 1). It is hypothesized that the perception assignment will lead to greater improvement in pronunciation because it was specifically designed to direct students' attention to L2 speech sounds more than typical assignments do. As described in Chapter 2, half of the target /e/ and /o/ vowels were in real words and half were in nonce words. Each of these conditions contained eight stimulus items for each vowel. Each of these stimulus items was presented only once; therefore, the maximum number of productions available for analysis in each of these two conditions is eight times the number of participants (120 for the production group and 104 for the perception group). Productions were not considered for analysis if the target word was not pronounced correctly or was not completed (e.g. [p^ha.ko^w] for *poco* {in this example, the first /o/ was not considered for analysis, but the second /o/ was}, [tɪɪ:] for *tristeza*, [aba:] for *aboche*, [pe.da.sa] for *padeso*), or if it was skipped altogether. Given these periodic mistakes during the production of the stimulus items, the number of productions available for analysis was somewhat smaller than the total number of productions. In the following sections, the vowels /e/ and /o/ are examined separately.

3.2.1.2 Mid vowel /e/

As explained in Chapter 2, diphthongization of the /e/ vowel is measured as the change in F1 and F2 throughout the articulation of the vowel. For each production of /e/ in the pretest and posttest, the value of F2-F1 at time 1 (T1) was subtracted from that at time 2 (T2). Large differences between F2-F1 at T1 and T2 indicate high degrees of diphthongization, and values closer to zero represent more target-like articulations of the vowel. Average diphthongization on the pretest and posttest is shown in each condition (real versus nonce words) and for each group. Because there are two conditions on each of two tests, there are 4 groups for which average diphthongization was calculated within each group: 1) pretest - real words 2) pretest - nonce

words 3) posttest - real words 4) posttest - nonce words. These data vowel are provided below in Table 3-1 and are shown graphically in Figure 3-1.

Table 3-1. Data for the diphthongization of the /e/ vowel.

Group	Pretest				Posttest			
	Real		Nonce		Real		Nonce	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Product.	99.79	143.7	73.53	148.3	110.81	138.0	67.81	137.0
Percept.	140.41	154.4	83.16	152.0	64.12	121.9	45.47	146.5

Note: Average diphthongization (in Hz) of the /e/ vowel, along with standard deviations, is shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

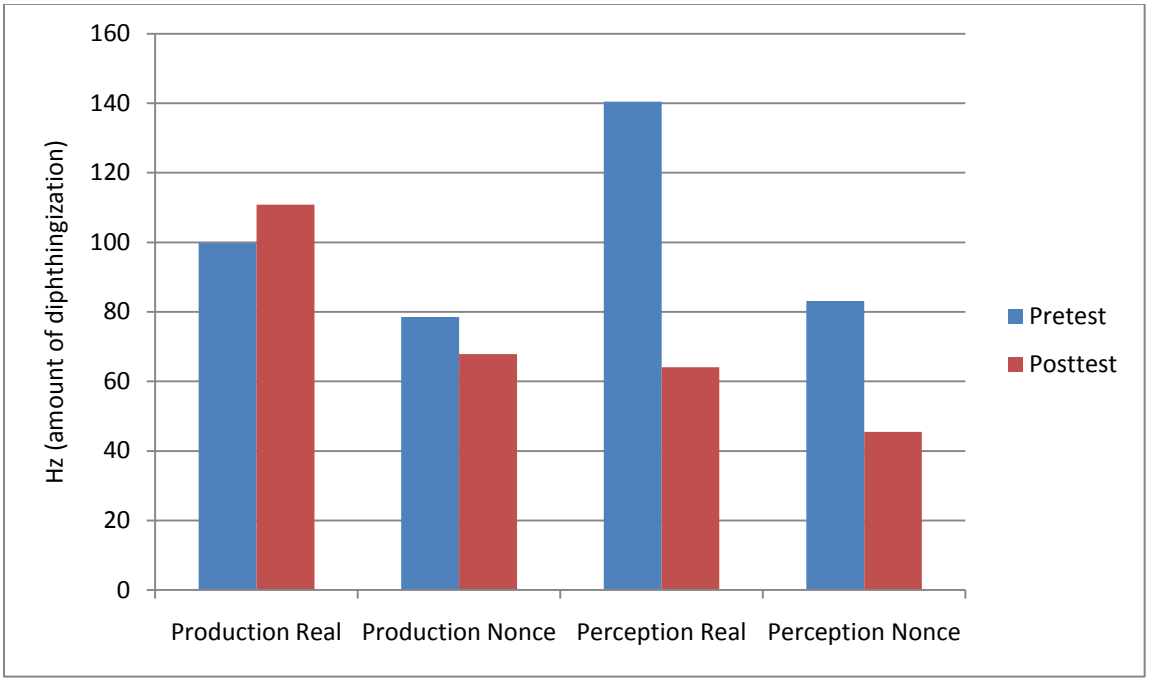


Figure 3-1. Graph of the diphthongization of the /e/ vowel.
Data are shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

For the production group, a 2 (test time: pretest and posttest) x 2 (word type: real and nonce) Factorial Repeated Measures ANOVA reveals only a main effect of word type ($F_{1, 115} = 5.328$, $p = .023$) with the /e/ vowel. For the perception group, a 2 (test time: pretest and posttest) x 2 (word type: real and nonce) Factorial Repeated Measures ANOVA reveals a main effect of test time ($F_{1,93} = 23.779$, $p < .001$) and word type ($F_{1, 93} = 6.021$, $p = .016$) with the /e/ vowel. These results suggest that with the /e/ vowel, the production group did not improve from the pretest to the posttest, but the perception group did. Furthermore, they suggest that the /e/ vowel was diphthongized significantly less in nonce words compared to real words.

3.2.1.1 Mid vowel /o/

Improvement with the /o/ vowels was measured similarly to the /e/ vowels, but only the change in F1 was calculated (i.e. F1(T1) – F1(T2), see Chapter 2). As with the /e/ vowel, values closer to zero indicate more native-like articulations. Values for the drop in F1 with diphthongized /o/ vowels are smaller than values for the increase in F2-F1 with diphthongized /e/ vowels. This is a natural result of differences in the degree to which F1 and F2 change throughout the articulation of /e/ and /o/, so these smaller values do not indicate less diphthongization relative to the /e/ vowels. See Table 3-2 below for measurements of the average diphthongization of /o/ in each condition, and view Figure 3-3 for a graphical representation of these data.

Table 3-2. Data for the diphthongization of the /o/ vowel.

Group	Pretest				Posttest			
	Real		Nonce		Real		Nonce	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Product.	45.50	66.26	33.00	53.68	39.29	62.79	30.83	51.83
Percept.	38.16	51.78	35.20	60.54	8.63	26.02	10.18	39.74

Note: Average diphthongization (in Hz) of the /o/ vowel, along with standard deviations, is shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

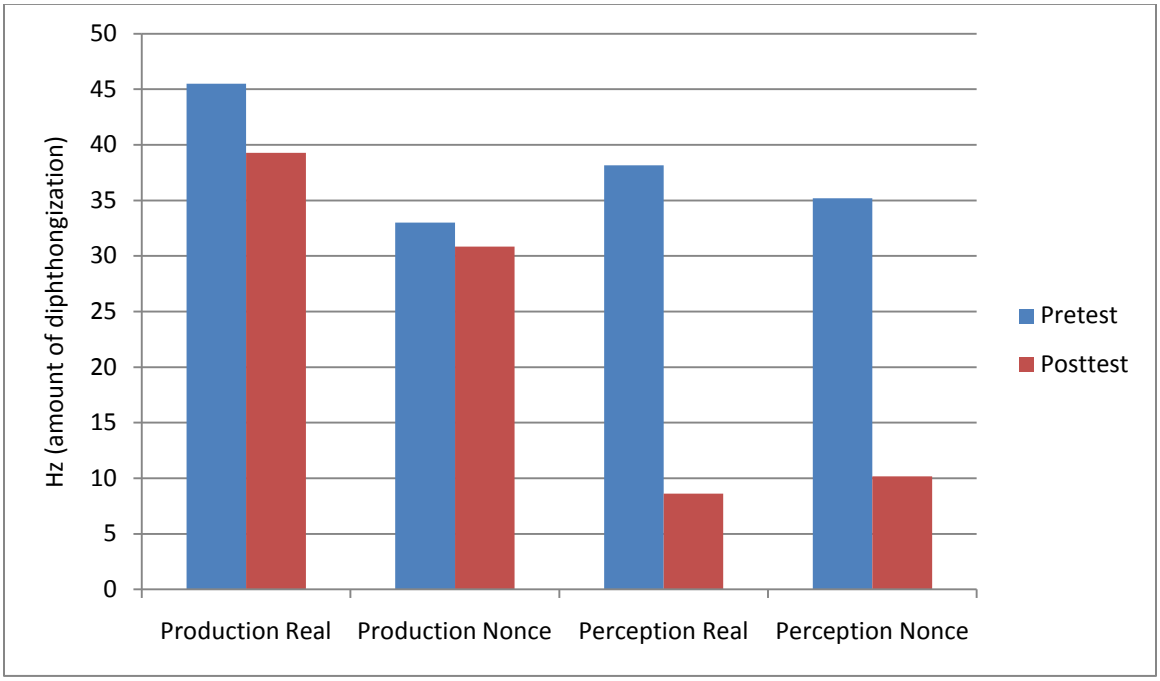


Figure 3-2. Graph of the diphthongization of the /o/ vowel.
Data are shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

A 2 (test time: pretest and posttest) x 2 (word type: real and nonce) Factorial Repeated Measures Analysis of Variance (ANOVA) does not reveal any main effect or any significant interaction for the production group on the /o/ vowel. A 2 (test time: pretest and posttest) x 2 (word type: real and nonce) Factorial Repeated Measures ANOVA reveals only a main effect of test time ($F_{1,97}$ = 37.561, $p < .001$) for the perception group on the /o/ vowel. These results suggest that with the /o/ vowel, similarly to the /e/ vowel, the production group did not improve from the pretest to the posttest, but the perception group did. Moreover, these results indicate no significant difference in the diphthongization of the /o/ vowel in real words compared to nonce words. So far, it appears that a pronunciation assignment designed to direct students' attention to L2 speech sounds can lead to measureable gains in those students' pronunciation. However, further

analyses must be conducted to conclude that the findings on the tests reported above are, in fact, the result of the differences in the pronunciation assignment. To this end, attention is now turned to analyses of the individual difference measures that were collected (as described in Chapter 2).

3.2.1.3 Individual differences: proficiency and inhibitory control measures

Given that different groups of students made up the two groups being compared in this study, it is important to consider the proficiency and inhibitory control measures for each group and verify that there are no significant differences. This is because if one group was more proficient than the other or exhibited better inhibitory control than the other at the beginning of the study, that group may have an unfair advantage over the other group. If this were the case, the legitimacy of the results suggesting that the perception group exhibited greater improvement would be compromised. As explained in Chapter 2, both a grammar and a vocabulary proficiency measure were collected. The results of these tests are provided for each group in table 3-3 below.

Table 3-3. Proficiency scores for each group.

Test	Production group			Perception group			T-test
	Mean	Median	St.Dev.	Mean	Median	St.Dev.	
Grammar	20.000	19.00	4.26	20.923	22.00	5.52	p = .629
Vocabulary	14.400	14.00	4.54	16.385	14.00	8.36	p = .455

Note: Mean and median grammar and vocabulary proficiency scores are provided for each group. P values of t-tests comparing the means of the two groups are also provided.

The results in Table 3-3 illustrate that there are no significant differences between the two groups for either proficiency score. The standard deviation for the perception group on the vocabulary proficiency test, however, is noticeably higher than that for the production group. The higher standard deviation, along with a higher mean for the perception group, suggests that the perception group may have included participants noticeably more proficient than the rest of the participants. See the next section (3.2.1.4) for more details regarding the potential implications of this difference.

As explained in Chapter 2, the Simon task was also administered to all participants to measure their inhibitory control. Participants' inhibitory control was measured because if one group was significantly more able to direct attention to relevant information, that group may exhibit greater improvement than the other one. If this were the case with the perception group, it would be difficult to conclude whether the greater improvement was due to the assignment or the greater inhibitory control. The results on the Simon task for each group are given below in Table 3-4 below.

Table 3-4. Simon scores for each group.

Test	Production group			Perception group			T-test
	Mean	Median	St.Dev.	Mean	Median	St.Dev.	
Simon task	37.571	37.34	14.85	42.002	37.88	30.52	p = .640

Note: Mean and median scores on the Simon task are provided for each group. P values of t-tests comparing mean scores of the two groups are also provided.

Similarly to the results on the proficiency tests, the results of the Simon task indicate that there was no significant difference between the two groups but that there was a higher standard

deviation and slightly higher mean for the perception group. As with the proficiency scores, this indicates that the perception group may have included a select few participants with better inhibitory control than the rest of the participants. Given that the perception group exhibited improvement in the production of /e/ and /o/ while the production group did not (see 3.2.1.1 and 3.2.1.2 above), it is important to question whether this improvement was the result of a select few participants from the perception group that exhibited higher proficiency and inhibitory control. To consider this issue, correlations between performance and these individual differences are addressed in the next section.

3.2.1.4 Correlations between performance and individual differences

Pearson's correlation tests were carried out using the PASW Statistics GradPack 17.0 (SPSS, Inc., www.spss.com) to test whether either performance on the pretest or improvement from the pretest to the posttest was driven by grammar proficiency, vocabulary proficiency or inhibitory control. On these tests, a correlation coefficient (*r*) reveals the degree to which the two variables compared are correlated. The closer the correlation coefficient is to 1 or -1, the more the two variables are correlated, while a correlation coefficient close to 0 indicates that the two variables are not correlated. Given that the two groups were found to be comparable on all measures collected, they were combined for tests of correlation between individual difference measures and pretest performance. That is, all 28 participants were used to test whether the proficiency or inhibitory control measures correlated with performance on the pretest. The quantified value of diphthongization, as described in Chapter 2, represented performance on the pretest, and correlation tests included performance on the /e/ vowel and /o/ vowel separately. However, because only the perception group improved their pronunciation of /e/ and /o/, the tests of correlation between individual difference measures and improvement included participants

from each group separately. Improvement was operationalized by subtracting performance (i.e. the quantified value of diphthongization) on the posttest from performance on the pretest, and each vowel, /e/ and /o/, was considered separately.

Correlation tests between the individual difference measures and pretest performance on the /e/ vowel were conducted first. Results indicate that there was no correlation between pretest performance and the Simon score (r = -.043, p = .184), the grammar proficiency score (r = -.084, p = .041), or the vocabulary proficiency score (r = -.055, p = .125). Correlation tests between the individual difference measures and pretest performance on the /o/ vowel reveal that there was no correlation between pretest performance and the Simon score (r = .037, p = .220), the grammar proficiency score (r = -.006, p = .454), or the vocabulary proficiency score (r = .074, p = .062). With results indicating no correlation between the individual differences and performance on the pretest, tests of correlation were then carried out between the individual difference measures and improvement from the pretest to the posttest for each vowel and each group. For the perception group, results of the correlation tests indicate that there was no correlation between improvement with the /e/ vowel and the Simon score (r = .073, p = .153), the grammar proficiency score (r = .088, p = .107), or the vocabulary proficiency score (r = .018, p = .401). Likewise, with the /o/ vowel, there was no correlation between improvement and the Simon score (r = .000, p = .500), the grammar proficiency score (r = .035, p = .313), or the vocabulary proficiency score (r = .022, p = .380). For the production group, there was no correlation between improvement with the /e/ vowel and the Simon score (r = .036, p = .226), the grammar proficiency score (r = .102, p = .017), or the vocabulary proficiency score (r = .064, p = .090). Similarly, there was no correlation between improvement with the /o/ vowel and the Simon score (r = .015, p = .380), the grammar proficiency score (r = .019, p = .350), or the vocabulary proficiency score (r = .004, p = .464).

On all correlation tests carried out between the individual difference measures and performance and improvement, the Pearson product-moment correlation coefficient (*r*) was found

to be less than .1 (or greater than -.1 if negative). See Appendix F for dot plots of the Pearson correlation tests for all correlations tested. These results suggest that in addition to there being no significant differences between groups on these individual difference measures, there was also no correlation between these measures and performance or improvement on pronunciation.

3.2.1.5 Summary

The primary conclusion that can be drawn from the data is that the perception group improved significantly (i.e. exhibited less average diphthongization on the posttest than the pretest) while the production group did not. This is evidenced in a main effect of test time (from pretest to posttest) for both vowels with the perception group and a lack of main effect of test time with the production group (see 3.2.1.1 and 3.2.1.2 above). These results suggest that assignments specifically designed to increase students' attention to L2 sounds can lead to measureable improvement in students' pronunciation. Furthermore, the two groups compared here are not significantly different in their level of proficiency or in their inhibitory control as measured by the Simon task. Tests of correlation also indicate that these measures of proficiency and inhibitory control do not play a predictive role or correlate with performance or improvement in pronunciation. Attention is now turned to research question 2.

3.2.2 Research question 2

When receiving instruction on pronunciation, do learners improve their pronunciation less on words they learned early relative to new words or words they learned later?

As explained in Chapter 1, SLLs that do not receive pronunciation instruction in early stages of learning may solidify an incorrect pronunciation for L2 words for which they are

gradually solidifying lexical entries in their lexicon. If this is the case, instruction on pronunciation should arguably be given early in L2 curricula. This study probed this question by comparing real words (chosen to be words learned early and used frequently in the L2 classroom, i.e. *coche* "car," *poco* "little," *tarde* "late," *cabeza* "head") with nonce words. Given that the nonce words were designed to follow the phonotactics of Spanish, they represented the scenario in which SLLs of Spanish encounter new Spanish words for the first time. The use of nonce words in this manner provides a way to analyze learners' pronunciation when they pronounce words "in Spanish" but for which they have no lexical entry.

The answer to this research question lies in the data presented to answer research question 1. Analyses of variance performed on the data presented in Tables 3-1 and 3-2 and Figures 3-1 and 3-2 revealed no main effect of word type for either group on the /o/ vowel but a main effect of word type for both the production ($F_{1, 115} = 5.328$, $p = .023$) and the perception ($F_{1, 93} = 6.021$, $p = .016$) group on the /e/ vowel. To facilitate the examination of Figures 3-1 and 3-2 for the purposes of answering this question, Figures 3-1 and 3-2 are duplicated as Figures 3-3 and 3-4 below.

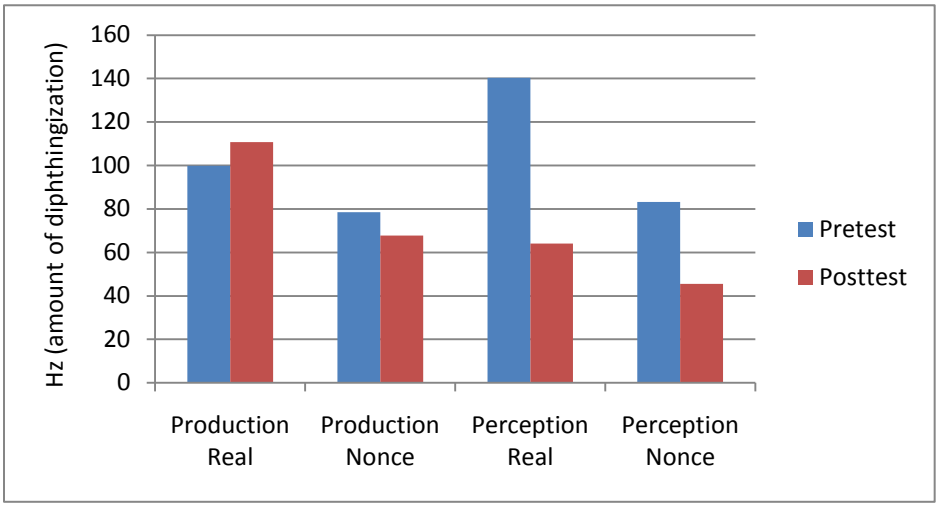


Figure 3-3. Graph of the diphthongization of the /e/ vowel.
Note: Data are shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

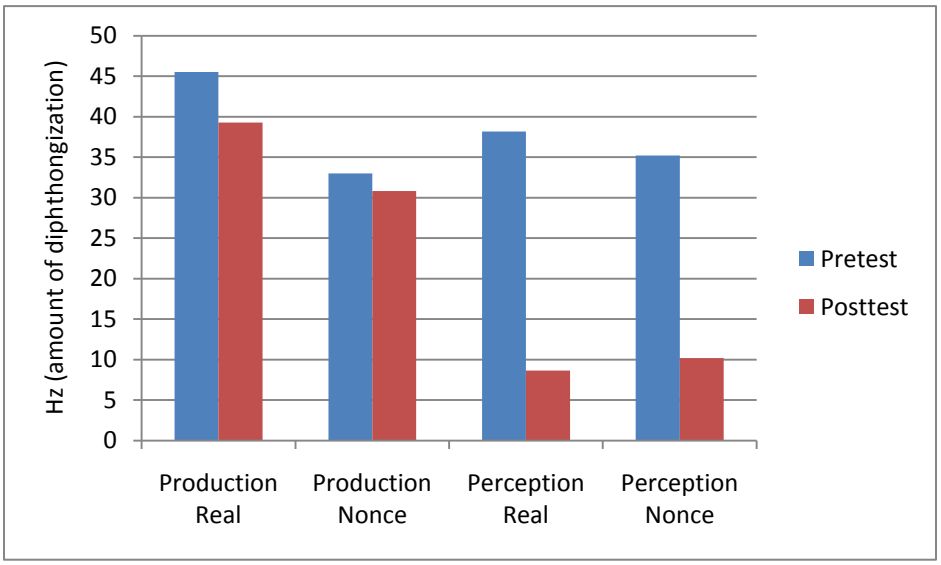


Figure 3-4. Graph of the diphthongization of the /o/ vowel.
Data are shown for both groups (production and perception) at both test times (pretest and posttest) in both conditions (real and nonce).

An examination of Figure 3-3 reveals that the main effect of word type for the /e/ vowel is the result of less diphthongization of the /e/ vowel in nonce words vis-à-vis real words. Moreover, although no main effect of word type was found with the /o/ vowel, the trend of less diphthongization in nonce words than real words can also be seen in Figure 3-4 with the /o/ vowel. These findings suggest that after improving pronunciation in Spanish, learners probably exhibit worse pronunciation on words learned early, but further analyses and future research are required to confirm this possibility. For further discussion regarding this question, see 3.3 below and Chapter 4.

3.3 Non-parametric statistics

As the number of participants in the study is relatively small, non-parametric statistical analyses were also carried out to verify conclusions drawn from the analyses presented above. These analyses are provided for each research question separately in the sections below. Non-parametric statistical tests are designed to be stricter in calculating the significance of a difference or effect. If a significant difference is found using non-parametric statistical tests, the same difference should be significant using parametric statistical tests, but the opposite is not necessarily true. Therefore, given that no significant improvement was found from the pretest to the posttest for the production group using the parametric statistical tests above, it is expected that no significant improvement would be found for the production group using non-parametric statistical tests. Because the question of interest for research question 1 is whether non-parametric statistics supports the conclusion that the perception group improved, non-parametric statistical analyses testing for improvement were only carried out on data from the perception group. In considering research question 2, however, data from both groups were used for analyses, but only data for the /e/ vowel were included. This is because neither group exhibited a

difference in the diphthongization of the /o/ vowel in real words vis-à-vis nonce words, but both groups exhibited such a difference in the diphthongization of the /e/ vowel.

3.3.1 Research question 1

Does the pronunciation assignment specifically designed to direct students' attention to L2 pronunciation result in greater, measurable gains in pronunciation compared to a more typical type of pronunciation assignment?

The Wilcoxon signed-rank test (Wilcoxon, 1945) was used to compare the perception group's pretest and posttest performance on each vowel (/e/ and /o/) and in each condition (real words and nonce words). That is, within each vowel and within each condition (totaling four analyses: 1) /e/ vowel in real words, 2) /e/ vowel in nonce words, 3) /o/ vowel in real words, 4) /o/ vowel in nonce words), posttest performance was compared with pretest performance to test for improvement. The Wilcoxon signed-rank test can be thought of as a non-parametric equivalent of the dependent t-test and was carried out using the statistical software PAWS Statistics Gradpack 17.0 (SPSS, Inc., www.spss.com). The results are provided for each of these four analyses below, and interpretations of the results follow.

Results for the /o/ vowel in real words indicated significantly less diphthongization on the posttest relative to the pretest ($z = -4.550$, $p < .001$, $r = -.33$). For the /o/ vowel in nonce words, results also revealed significantly less diphthongization on the posttest than the pretest ($z = -3.600$, $p < .001$, $r = -.26$). Likewise, for the /e/ vowel, results indicated significantly less diphthongization on the posttest than the pretest in both real words ($z = -4.727$, $p < .001$, $r = -.34$) and nonce words ($z = -2.853$, $p = .004$, $r = -.21$). These results support the conclusion that the perception group improved in their diphthongization of both the /e/ and the /o/ vowels in both real and nonce words.

3.3.2 Research question 2

It is shown above in 3.2.2 that participants in both groups diphthongized the /e/ vowel less in nonce words than in real words. To verify this finding using non-parametric statistical tests, the following four analyses are carried out using Wilcoxon signed-rank tests: 1) the production group's performance on the pretest, 2) the production group's performance on the posttest, 3) the perception group's performance on the pretest, 4) the perception group's performance on the posttest. In each of these analyses, performance on the /e/ vowel in real words is compared to performance on the /e/ vowel in nonce words. The results of these four analyses are provided below.

On the pretest, the perception group diphthongized the /e/ vowel in nonce words significantly less than in real words ($z = -2.580$, $p = .010$, $r = -.19$), but on the posttest, while /e/ was diphthongized less in nonce words than in real words, this difference is not significant ($z = -1.209$, $p = .227$, $r = -.09$). It can be seen in Figure 3-3 that the lack of a significant difference on the posttest is due to the perception group's improvement with the /e/ vowel in real words. With the production group, the same trend is found, in which the /e/ vowel was diphthongized less in nonce words than in real words. However, this difference is not significant on the pretest although it approaches significance ($z = -1.756$, $p = .079$, $r = -.12$), but it is significant on the posttest ($z = -2.849$, $p = .004$, $r = -.19$). These results do not completely answer whether or not it is harder to improve pronunciation on words learned early compared to new or more recently learned words. However, the fact that the /e/ vowel was diphthongized significantly less in nonce words compared to real words in some situations, coupled with a visual examination of the data shown in Figures 3-1 and 3-2 (duplicated as Figures 3-3 and 3-4) above, suggests that it *may* be more difficult to improve the pronunciation of words learned early, but, as suggested in 3.2.2,

future research should consider investigating this question further. Also, see Chapter 4 for further discussion regarding this question.

3.4 Analysis of students' feedback

Results of this study indicate that the students receiving the perception assignment improved while those receiving the production assignment did not. Because it is assumed that the improvement for the perception group was due to focusing attention to the target L2 sounds, it is worth verifying that the students receiving the perception assignment attended to correct and incorrect articulations of the vowels /e/ and /o/ during the assignments. An initial examination of the assignments submitted by the students in the perception group reveals that the students, in fact, directed attention to the vowels /e/ and /o/. See Figures 3-5 and 3-6 for examples of the feedback provided on the first perception assignment and Figure 3-7 for an example of the feedback provided on the third one.

Pablo: ¿Ves cómo ya nos atienden? Te pones insoportable. Ya sabes que a papá le hace mucha ilusión este viaje.

Laura: Oye, aquí no figura ninguna reservación a nombre del señor Fuentes. ¿No la tendrás tú en tu computadora?

Jorge: Por favor, Laura, no puedo hacerlo solo. Mira la gente que tengo. Si no figura ahí, será que no hicieron reservación.

Juan: ¿Cómo que no hicimos reservación? Entonces mi padres es un mentiroso.

Don Antonio: Por favor, hijo, no te metas donde no te han llamado. ... Nosotros llamamos la semana pasada, desde San José. Me aseguraron que podía contar con las habitaciones.

Laura: Pues aquí no aparece registrado, lo siento, señor. ¿Recuerda con quién habló?

Don Antonio: Lo tengo apuntado en algún sitio espero que lo estoy buscando.

Juan: Lo de siempre. Papá es un completo desorden.

Don Antonio: Aquí está la información, pero falta el nombre del hombre con quien hablé. Creo que se llamaba Miguel Ramírez o Miguel Domínguez. Sí, eso fue, Miguel Domínguez.

Jorge: Aquí no hay ningún empleado con ese nombre. Perdone, señor, ¿a qué hotel viene?

Don Antonio: Al Hotel Bellavista.

Figure 3-5. Example one of a student's feedback on the first assignment.

Pablo: ¿Ves cómo ya nos atienden? Te pones insoportable. Ya sabes que a papá le hace mucha ilusión este viaje.

Laura: Oye, aquí no figura ninguna reservación a nombre del señor Fuentes. ¿No la tendrás tú en tu computadora?

Jorge: Por favor, Laura, no puedo hacerlo todo. Mira la gente que tengo. Si no figura ahí, será que no hicieron reservación.

Juan: ¿Cómo que no hicimos reservación? Entonces mi padres es un mentiroso.

Don Antonio: Por favor, hijo, no te metas donde no te han llamado. ... Nosotros llamamos la semana pasada desde San José. Me aseguraron que podía contar con las habitaciones.

Laura: Pues aquí no aparece registrado. Lo siento, señor. ¿Recuerda con quién habló?

Don Antonio: Lo tengo apuntado en algún sitio, espere que lo estoy buscando.

Juan: Lo de siempre. Papá es un completo desorden.

Don Antonio: Aquí está la información, pero falta el nombre del hombre con quien hablé. Creo que se llamaba Miguel Ramírez o Miguel Domínguez. Si eso fue, Miguel Domínguez.

Jorge: Aquí no hay ningún empleado con ese nombre. Perdone, señor, ¿a qué hotel viene?

Don Antonio: Al Hotel Bellavista.

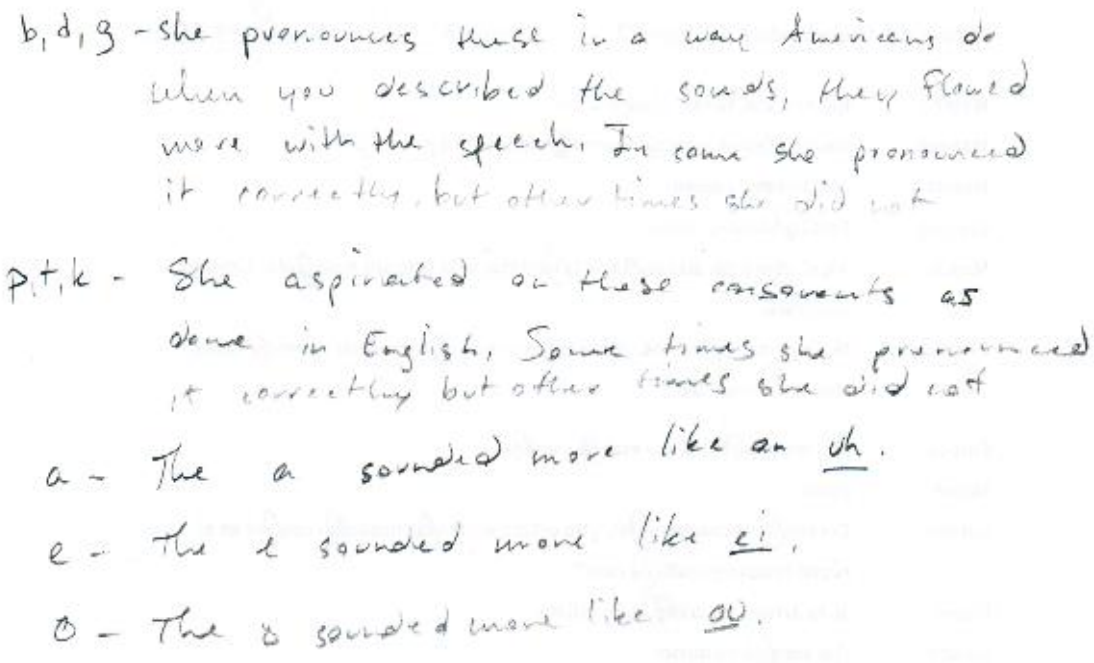
(a) - In terms of all the circled a's, he makes the a's sound more like uh's.

(e) - he makes the e's sound like ei's which is not how to pronounce the e's

(o) - he makes the o's sound like ou's which also describes the american accent.

Figure 3-6. Example two of a student's feedback on the first assignment.
Written feedback at the bottom says as follows: (a) – in terms of all the circled a's, he makes the a's sound more like uh's. (e) – he makes the e's sound like ei's which is not how to pronounce the e's. (o) – he makes the o's sound like ou's which also describes the american accent.

Mesero:	Buenos días, señor. ¿Cuántos son?
Manuel:	Cuatro. Tenemos mesa reservada para las dos y cuarto.
Mesero:	¿A nombre de quién?
Cristina:	Familia Sánchez Torres.
Mesero:	Ah, sí, aquí está. Es aquella de la ventana, se la preparo enseguida. Llegaron temprano.
Cristina:	No importa, esperamos. ¿Querés tomar una copa en el bar mientras tanto, Manolo? Tengo sed.
...	
Luisito:	Che, mira ese chico que está de espaldas.
Isabel:	¿Cuál?
Luisito:	Ese alto de la chaqueta gris. ¿No estaba el otro día hablando con vos en el portal cuando yo salía de casa?
Isabel:	Sí, es Arturo, un amigo, pero cállate.
Luisito:	¿Un amigo o un novio?
...	
Mesero:	Pasen, la mesa está lista.
Manuel:	Gracias. Vamos.
...	
Isabel:	Mamá, yo voy al baño. Vuelvo enseguida.
Cristina:	¿Querés que vaya con vos?
Isabel:	No, no hace falta. No soy una niña pequeña, mamá.
Cristina:	Sí, sé que hoy cumplís 18. Ya sos toda una señorita.
...	
Arturo:	¡Isabel! ¡Qué casualidad! ¿Qué hacés aquí? ¿Estás sola?
Isabel:	No, estoy con mi familia. Vinimos a celebrar mi cumpleaños. Hoy cumplo los 18. Vos lo sabías, ¿no?
Arturo:	Claro que lo sabía. Precisamente iba a llamarte esta tarde para que tomáramos algo. Toma, ¿querés uno? Están muy buenos.
Isabel:	No, gracias, llámame luego, me están esperando mis padres.
Arturo:	¿Aquéllos son tus padres?
Isabel:	Sí, pero no mires. Todavía no saben que salgo con vos.
Arturo:	¡Caramba! ¡Pero si es don Manuel Sánchez Torres, mi profesor de geología!


b, d, g - she pronounces these in a way Americans do when you described the sounds, they flowed more with the speech. In some she pronounced it correctly, but other times she did not

p, t, k - She aspirated on these consonants as done in English, Some times she pronounced it correctly but other times she did not

a - The a sounded more like an uh.

e - The e sounded more like ei.

o - The o sounded more like ou.

Figure 3-7. Example of a student's feedback on the third assignment.
Written feedback at the bottom says as follows: b, d, g, - she pronounces these in a way Americans do when you described the sounds, they flowed more with the speech. In some she pronounced it correctly, but other times she did not. p, t, k – She aspirated on these consonants as done in English. Sometimes she pronounced it correctly but often times she did not. a – The a sounded more like an uh. e – The e sounded more like ei. o – The o sounded more like ou.

Students were asked to focus specifically on the vowels /a/, /e/, and /o/ on the first assignment, so it is not surprising that they provided feedback primarily on these vowels. What is perhaps more important is that in later assignments, when students were instructed to focus on new sounds in addition to the vowels, indeed, students continued to focus on these vowels.

In addition to recognizing that students directed attention to the appropriate sounds in the assignments, a quantitative analysis of the feedback provided on these assignments was performed to calculate the general accuracy of the feedback. To do this, the instructor of the course also listened to the recordings that the students in the perception group were given and created a model assessment of the sounds that were not target-like. A comparison was made between the feedback provided by the students on the perception assignments and the model

assessment made by the instructor of the course. This analysis revealed that on the first perception assignment, 15.38% of the sounds marked by the instructor were also marked in the feedback provided by the students. In addition, on average, 8.67 sounds were marked on each assignment that were not marked by the instructor (referred to hereafter as *errors*). In comparison, on the third perception assignment, the students marked 20.5% of the sounds that were marked by the instructor, and there was an average of 10.0 errors on each student's assignment. A comparison between the third assignment and the first reveals that there was a trend for students to increase the accuracy of their feedback as their experience with the L2 sounds and the assignment increased. The students likely made more errors on the third assignment than the first, because they were instructed to provide feedback on more sounds. On the first assignment, students only provided feedback on the vowels /e/ and /o/, but on the third assignment, they provided feedback on /p, t, k, b, d, g/ in addition to the vowels /e/ and /o/. This led them to provide much more feedback on the third assignment relative to the first, increasing their chances of providing erroneous feedback. In summary, it is evident that students did not provide feedback identical to the assessment made by the instructor, but they did direct attention to the appropriate sounds and exhibited a trend towards improvement in the accuracy of the feedback.

3.5 Chapter summary

The two research questions presented in Chapter 1 are addressed in this chapter. Initial analyses indicate that the production group did not improve its pronunciation of the mid vowels (/e/ and /o/), while the perception group did. Moreover, both the production and perception groups diphthongized the /e/ vowel significantly less in nonce words than in real words. The same trend to diphthongize the mid vowels less in nonce words can be detected by an

examination of the data for the /o/ vowel, but this trend does not result in a significant difference. Non-parametric statistical analyses support the initial conclusion that the perception group improved their pronunciation of the mid vowels while the production group did not. Moreover, non-parametric tests also support the suggestion that participants pronounced the /e/ vowel better in nonce words relative to real words. In addition, an analysis of the feedback provided by the perception group suggests that they did attend to the mid vowels when completing the assignments. This finding is crucial for understanding how the perception assignment helped participants improve their pronunciation. In the next chapter (Chapter 4), attention is turned to the importance and implications of the findings shown in this chapter.

Chapter 4

Discussion and Conclusion

4.1 Introduction

The study presented in this dissertation and the results obtained are summarized and discussed in this chapter. The chapter is organized in the following manner. A brief overview of the study and the findings are provided in 4.2. Next, the relationship between vowel length and diphthongization is analyzed, leading to a more in-depth discussion of performance on real versus nonce words (4.3). This is followed by a discussion of the insights that have been gained by quantifying diphthongization in this study (4.4). Following this discussion, the implications of the findings in this study for second language pedagogy are considered (4.5) and questions that remain for future research are addressed (4.6).

4.2 Overview of the study and results

The main goal of the study presented in this dissertation was to investigate whether an assignment designed to direct students' attention to L2 pronunciation could help students improve their pronunciation over the course of a semester. A perception-based assignment was specifically designed to encourage students to attend to differences in L2 sounds that have proven to be difficult for English learners of Spanish. In this assignment, students were provided with recordings containing native English speakers' pronunciation of Spanish and were asked to provide feedback on their pronunciation. This assignment was compared to a more typical production-based assignment, in which students recorded themselves and received feedback on their pronunciation from the instructor. The degree of diphthongization of the vowels /e/ and /o/

was chosen as the focus of the study because it has received comparably less attention in the literature in spite of its contribution to foreign-accented speech. To measure students' improvement in the pronunciation of /e/ and /o/, they were recorded reading single words at the beginning (pretest) and end (posttest) of the semester. Acoustical analyses were then performed to quantify the amount of diphthongization of both vowels on the pretest and posttest. Results indicate that the students receiving the perception-based assignment improved in their pronunciation of the mid vowels /e/ and /o/, while the students receiving the production-based assignment did not. In addition, both groups diphthongized the /e/ vowel significantly less in nonce words compared to real words, and the same trend was observed for the /o/ vowel even though it was not significant for either group.

Measures of individual differences were also collected to determine whether there were any differences between the two groups that could account for the difference in results. These included a grammar and vocabulary proficiency measure and a measure of inhibitory control, measured by the Simon task. Analyses revealed no significant differences between the two groups in terms of these measures. In addition, no correlations were found between these measures and improvement with the vowels /e/ and /o/. These results suggest that the difference in improvement on the mid vowels was, indeed, due to the difference in assignment type. This conclusion assumes that participants in the perception group, in fact, directed attention to the vowels in the pronunciation assignments they completed. An observation and analysis of the assignments confirmed that these participants, in fact, directed attention to the vowels from the first assignment completed.

One factor that has not been discussed so far is the potential impact of vowel length on diphthongization. In English, unstressed vowels are usually reduced and, thus, shorter in duration relative to stressed vowels (McQueen and Cutler, 1997). Unstressed vowels in English are also usually less diphthongized compared to stressed vowels, arguably as a result of being reduced.

For these reasons, there is expected to be a correlation between vowel length and diphthongization of /e/ and /o/ for L1 English speakers. When L1 English learners of L2 Spanish transfer the tendency to diphthongize /e/ and /o/ to their developing Spanish phonological grammar, it is possible that they also transfer the correlation between vowel length and diphthongization. That is, it is possible that L1 English learners of Spanish diphthongize stressed /e/ and /o/ vowels more than unstressed /e/ and /o/ vowels as a result of longer vowel durations for the stressed ones. If the participants in this dissertation exhibited this pattern, it may be important to analyze the vowel length of stressed vowels relative to unstressed ones and how the findings of this analysis relate to diphthongization in this study. Attention is turned to this issue in the next section.

4.3 Vowel length and diphthongization

As mentioned above, stressed /e/ and /o/ vowels in English are usually longer in duration and more diphthongized than their unstressed counterparts. Because the participants in this study may have transferred this characteristic of English phonology to their Spanish, several analyses were conducted to examine the relationship between vowel length and diphthongization of the Spanish mid-vowels in this study. These are presented in the sections that follow.

4.3.1 Vowel length

Because different individuals exhibit different rates of speech, and because even the same individual speaks faster at some moments than at others, vowel length ratios were used in analyses of vowel length rather than pure vowel length measurements. To calculate these ratios, first, the length of all target vowels was measured in milliseconds. If the target vowel was word-

internal (i.e., in the penultimate syllable), the following vowel was also measured in milliseconds, but if the target vowel was word-final, the preceding vowel was measured in milliseconds. The ratio was calculated by dividing the duration of the target vowel by the duration of the vowel in the adjacent syllable. This ratio was calculated such that values of 1 indicate that the two vowels are identical in length, while values less than 1 indicate shorter target vowels (relative to those in the adjacent syllable) and values greater than 1 indicate longer target vowels.

To test the relationship between vowel length ratio and diphthongization, Pearson's correlations were carried out between the vowel length ratios and the quantified degrees of diphthongization. The correlations were performed for each group and with each vowel separately, yielding four total tests of correlation: 1) for the perception group's production of the /e/ vowel, 2) for the perception groups production of the /o/ vowel, 3) for the production group's production of the /e/ vowel, and 4) for the production group's production of the /o/ vowel. For the perception group's performance on the /e/ vowel, vowel length ratio was significantly correlated with diphthongization ($r = .299$, $p < .001$). On the perception group's performance of the /o/ vowel, however, no correlation between vowel length ratio and diphthongization was found ($r = -.046$, $p = .178$). For the production group, as with the perception group, there was a significant correlation between vowel length ratio and diphthongization of the /e/ vowel ($r = .170$, $p < .001$) but not the /o/ vowel ($r = -.040$, $p = .192$). These tests of correlation indicate a significant correlation between vowel length ratio and diphthongization of the /e/ vowel for both groups, but such a correlation was not found for either group with the /o/ vowel.

It is unclear why vowel length ratio was significantly correlated with diphthongization of the /e/ vowel but not the /o/ vowel. However, the fact that diphthongization of the /e/ vowel is correlated with vowel length raises questions about the role of vowel length in this study. Therefore, comparisons were made between the relative vowel lengths of the target vowels in word-internal position (referred to hereafter as medial vowels) and those in word-final position

(referred to hereafter as final vowels). As explained above, stressed vowels have longer durations in English, so it may be expected that English learners of Spanish would exhibit longer vowel durations on stressed vowels in Spanish. Given that all stimulus words used in this study were paroxytones (i.e. stressed on the next to the last syllable), medial vowels were always stressed and final vowels were always unstressed. Consequently, it is possible that participants pronounced medial vowels with longer durations than final ones. To test this, mean vowel length ratios (referred to hereafter as vowel length or duration for simplicity) for medial vowels were compared with those for final vowels. These comparisons were made for each group and each vowel separately, yielding four total comparisons: 1) /e/ vowel for the perception group, 2) /o/ vowel for the perception group, 3) /e/ vowel for the production group, and 4) /o/ vowel for the production group.

Comparisons between vowel duration on medial versus final vowels were first made with the perception group's productions of the /e/ vowel. Paired-samples t-tests reveal that on both the pretest ($t = -7.125$, $p < .001$) and the posttest ($t = -7.902$, $p < .001$), final vowels had a significantly longer duration than medial vowels. Furthermore, a 2 (test time: pretest and posttest) x 2 (vowel position: medial and final) Factorial Repeated Measures ANOVA reveals a main effect of vowel position ($F_{1,98} = 82.828$, $p < .001$) on vowel length ratio. With the perception group's productions of the /o/ vowel, paired-samples t-tests reveal that final vowels were significantly longer than medial ones on both the pretest ($t = -4.764$, $p < .001$) and the posttest ($t = -3.321$, $p < .001$). As with the /e/ vowel, a 2 (test time: pretest and posttest) x 2 (vowel position: medial and final) Factorial Repeated Measures ANOVA reveals a main effect of vowel position ($F_{1,98} = 25.630$, $p < .001$). The same trend for final vowels to be longer than medial ones was found for the production group, but there were also a couple of differences. With the /e/ vowel, paired-samples t-tests reveal that final vowels were significantly longer than medial ones on both the pretest ($t = -8.074$, $p < .001$) and the posttest ($t = -4.913$, $p < .001$). A 2

(test time: pretest and posttest) x 2 (vowel position: medial and final) Factorial Repeated Measures ANOVA, however, reveals both a main effect of vowel position ($F_{1,117} = 64.135$, $p < .001$) and a significant interaction between vowel position and test time ($F_{1,117} = 8.203$, $p < .01$). Paired-samples t-tests reveal that the /o/ vowel was longer in final position on the pretest ($t = -4.992$, $p < .001$) but not on the posttest ($t = -1.200$, $p = .233$). Moreover, a 2 (test time: pretest and posttest) x 2 (vowel position: medial and final) Factorial Repeated Measures ANOVA reveals a main effect of vowel position ($F_{1,115} = 10.682$, $p = .001$) and a significant interaction between vowel position and test time ($F_{1,115} = 7.237$, $p = .008$).

The analyses of vowel length reveal that, in fact, the stressed vowels in medial position were not longer than the unstressed vowels in final position; on the contrary, final vowels were longer than medial ones. While this result seems puzzling at first, it may be due to the fact that participants read only single words in isolation. While stressed vowels are longer in English, syllables are also lengthened in English at the end of intonational phrases (Klatt, 1976; Wightman, 1992; Campbell and Isard, 1991). This tendency to lengthen syllables at the end of intonational phrases in English would have arguably caused participants to lengthen the final syllable in the words they read on the pretest and posttest in this study. The result that final vowels were significantly longer than medial vowels in this study, coupled with the finding that vowel length was sometimes correlated with diphthongization (e.g. with the /e/ vowel), raised questions regarding the interaction between vowel position and diphthongization in this study. The next section provides an analysis and discussion of the role that vowel position played in the results of this study.

4.3.2 Vowel position and diphthongization

In Chapter 3, the data in this study were separated into four conditions for each vowel in each group; specifically, for both groups (perception and production) and for each vowel (/e/ and /o/) the following four conditions were compared: 1) real words on the pretest, 2) real words on the posttest, 3) nonce words on the pretest, and 4) nonce words on the posttest. In this section, the data are also separated by *vowel position* (referred to hereafter as position). Instead of four conditions, there are eight: 1) medial vowels in real words on the pretest, 2) final vowels in real words on the pretest, 3) medial vowels in real words on the posttest, 4) final vowels in real words on the posttest, 5) medial vowels in nonce words on the pretest, 6) final vowels in nonce words on the pretest, 7) final vowels in nonce words on the pretest, and 8) final vowels in nonce words on the posttest. As in Chapter 3, Factorial Repeated Measures ANOVAs were conducted to analyze the differences in the way these conditions impacted diphthongization in this study. These analyses are presented below, first for the /e/ vowel, then for the /o/ vowel.

4.3.2.1 Analyses with the /e/ vowel

Analyses were first carried out on the production group's performance with the /e/ vowel. Average measurements of diphthongization are presented in Table 4-1, and these measurements are illustrated graphically in Figure 4-1 below.

Table 4-1 Average diphthongization of the /e/ vowel in each condition on each test for the production group.

Conditions	Pretest		Posttest	
	Mean	**St. Dev.**	**Mean**	**St. Dev.**
Real Medial	66.22	129.990	85.57	144.774
Real Final	133.36	149.869	136.05	127.210
Nonce Medial	15.16	137.484	3.00	117.457
Nonce Final	131.90	136.221	132.62	124.690

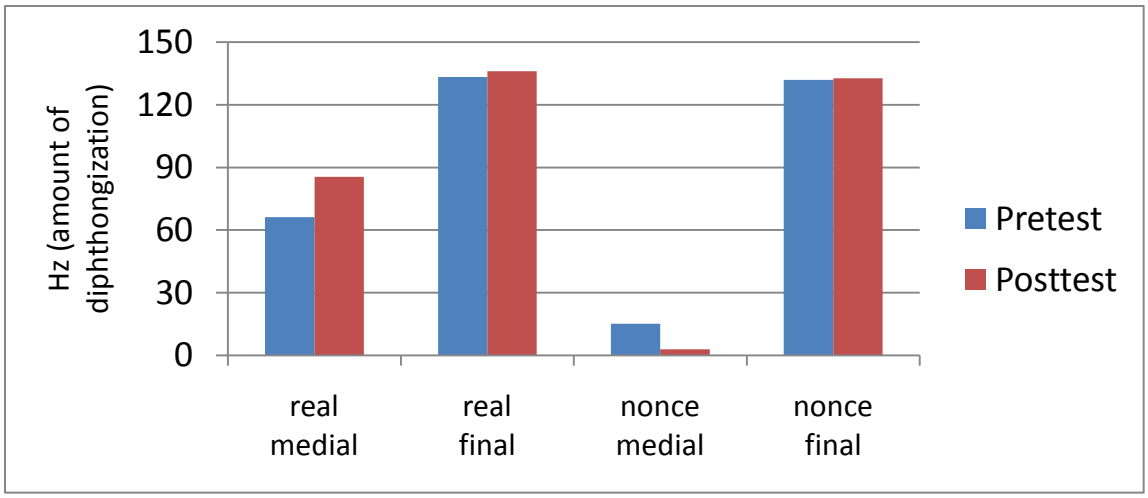


Figure 4-1. Production group's performance on the /e/ vowel.
Each bar represents the average degree of diphthongization. Bars on the left in each pair indicate performance on the pretest and bars on the right indicate performance on the posttest. The vertical axis shows the measure of diphthongization calculated by F2-F1(time 1) – F2-F1(time 2). The horizontal axis shows each condition.

A 2 (test: pre, post) x 2 (word type: real, nonce) x 2 (position: medial, final) Factorial Repeated Measures ANOVA reveals a main effect of word type ($F_{1,57}$ = 5.972, p = .018), a main effect of

position ($F_{1,57}$ = 37.835, p = .000), and a significant interaction between word type and position ($F_{1,57}$ = 4.404, p = .040). There was no effect or interaction for test, which indicates that there was no change in performance from pretest to posttest for the production group. Final vowels were diphthongized more than medial vowels, as exhibited by the main effect of position. The main effect of word type and the interaction between word type and position reveals that in the medial conditions, vowels in nonce words were diphthongized less than those in real words.

Average diphthongization of /e/ in each condition is shown for the perception group below in Table 4-2. A graphical representation of these averages is then shown in Figure 4-2.

Table 4-2 Average diphthongization of the /e/ vowel in each condition on each test for the perception group.

Condition	Pretest		Posttest	
	Mean	**St. Dev.**	**Mean**	**St. Dev.**
Real Medial	95.49	145.454	33.40	103.404
Real Final	185.34	151.313	94.83	131.981
Nonce Medial	5.36	138.166	-7.47	94.151
Nonce Final	160.96	123.401	98.40	169.703

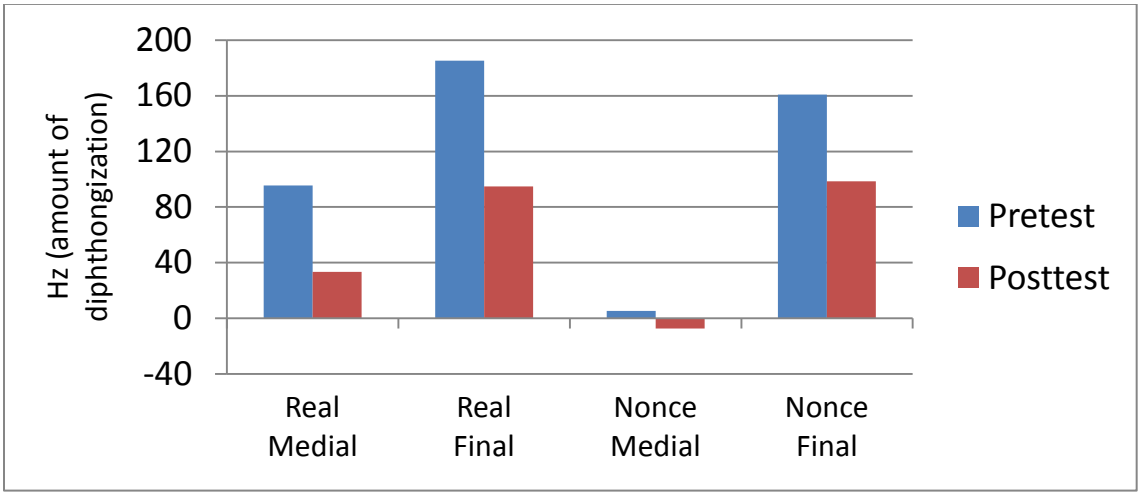


Figure 4-2. Perception group's performance on the /e/ vowel.
Each bar represents the average degree of diphthongization. Bars on the left in each pair indicate performance on the pretest and bars on the right indicate performance on the posttest. The vertical axis shows the measure of diphthongization calculated by F2-F1(time 1) – F2-F1(time 2). The horizontal axis shows each condition.

For the perception group, A 2 (test: pre, post) x 2 (word type: real, nonce) x 2 (position: medial, final) Factorial Repeated Measures ANOVA reveals that there are three main effects: a main effect of test ($F_{1,46}$ = 22.950, p = .000), a main effect of word type ($F_{1,46}$ = 5.637, p = .022), and a main effect of position ($F_{1,46}$ = 32.031, p = .000). While there was no significant interaction, the interaction between word type and position approached significance ($F_{1,46}$ = 3.586, p = .065). The main effect of test confirms that diphthongization on the posttest was less than on the pretest. The effect of position indicates that final vowels were diphthongized more than medial ones. As indicated by the main effect of word type, nonce words were diphthongized less than real words, but this effect was driven by the interaction between word type and position, which approached significance. The reduced diphthongization with nonce words was primarily found for medial vowels.

4.3.2.2 Analyses with the /o/ vowel

As with the /e/ vowel, analyses with the /o/ vowel were first conducted with the production group. Average diphthongization measurements for the production group are presented in Table 4-3, and these measurements are shown graphically in Figure 4-3.

Table 4-3. Average diphthongization of the /o/ vowel in each condition on each test for the production group.

Condition	Pretest		Posttest	
	Mean	**St. Dev.**	**Mean**	**St. Dev.**
Real Medial	43.30	56.124	39.00	58.518
Real Final	47.70	75.495	39.57	67.320
Nonce Medial	17.91	29.885	20.27	35.042
Nonce Final	48.09	66.774	41.39	62.971

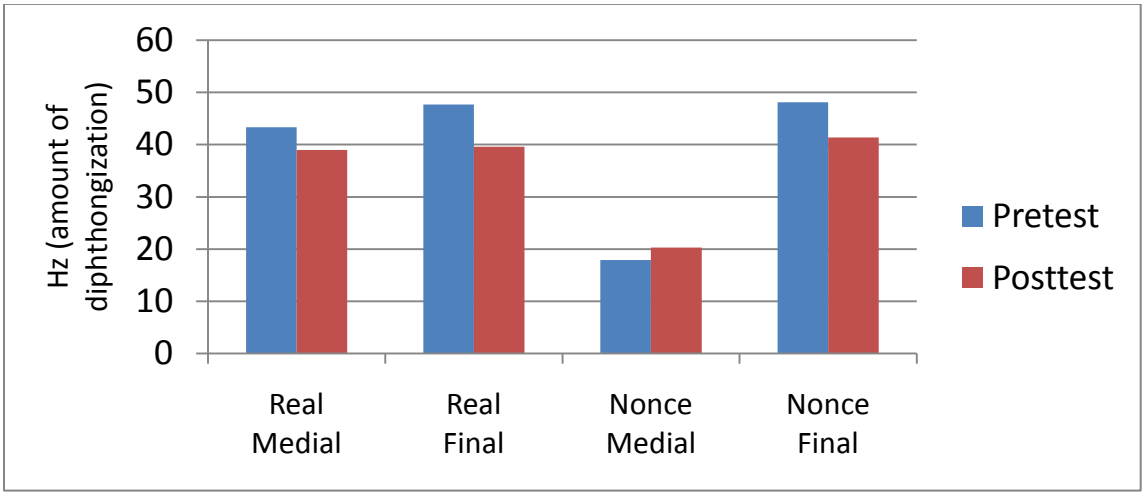


Figure 4-3. Production group's performance on the /o/ vowel.
Each bar represents the average degree of diphthongization. Bars on the left in each pair indicate performance on the pretest and bars on the right indicate performance on the posttest. The vertical axis shows the measure of diphthongization calculated by F2-F1(time 1) – F2-F1(time 2). The horizontal axis shows each condition.

A 2 (test: pre, post) x 2 (word type: real, nonce) x 2 (position: medial, final) Factorial Repeated Measures ANOVA for the production group's performance on the /o/ vowel only exhibits a main effect of position ($F_{1,55} = 5.075$, $p = .028$) and an interaction that approached significance between word type and position ($F_{1,55} = 3.752$, $p = .058$). These results suggest that there was no change in diphthongization from the pretest to the posttest, but medial vowels were diphthongized significantly less in nonce words overall.

Results for the perception group's performance with the /o/ vowel are provided in Table 4-4 and depicted graphically in Figure 4-4 below.

Table 4-4. Average diphthongization of the /o/ vowel in each condition on each test for the perception group.

Condition	Pretest		Posttest	
	Mean	**St. Dev**	**Mean**	**St. Dev.**
Real Medial	31.35	40.941	11.00	24.558
Real Final	44.98	60.398	6.27	27.450
Nonce Medial	13.94	30.233	9.90	38.756
Nonce Final	56.47	74.624	10.47	41.094

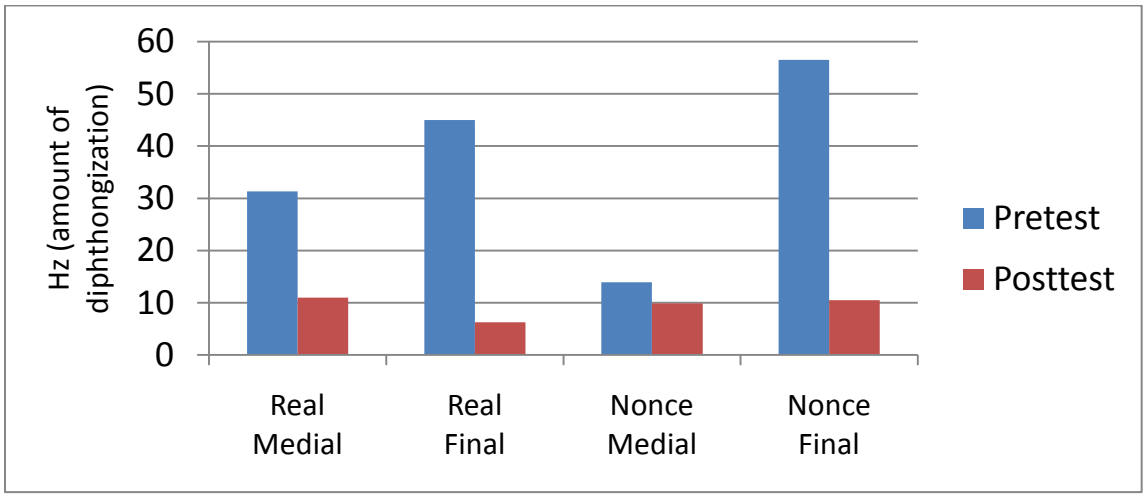


Figure 4-4. Perception group's performance on the /o/ vowel.
Each bar represents the average degree of diphthongization. Bars on the left in each pair indicate performance on the pretest and bars on the right indicate performance on the posttest. The vertical axis shows the measure of diphthongization calculated by F2-F1(time 1) – F2-F1(time 2). The horizontal axis shows each condition.

A 2 (test: pre, post) x 2 (word type: real, nonce) x 2 (position: medial, final) Factorial Repeated Measures ANOVA indicates a main effect of test ($F_{1,48}$ = 52.802, p = .000), a main effect of position ($F_{1,48}$ = 7.506, p = .009), and a significant interaction between test and position ($F_{1,48}$ = 10.730, p = .002). An interaction between word type and position also approached significance ($F_{1,48}$ = 3.091, p = .085).[3] These results indicate that participants diphthongized the /o/ vowel significantly less during the posttest relative to the pretest. The main effect of position indicates that final vowels were diphthongized more than medial ones, and the interaction between test and position is the result of there being little diphthongization with medial vowels in nonce words during the pretest (i.e. participants did not improve in this condition because there was little room to improve).

In summary, the results presented in this section suggest that medial vowels in nonce words were diphthongized less than the vowels in all other conditions. This leads to the need to return to research question 2 and reconsider the effect of word type on diphthongization in this study. Attention is turned to this issue in the next section.

4.3.3 Revisiting research question 2

When receiving instruction on pronunciation, do learners improve their pronunciation less on words they learned early relative to new words or words they learned later?

[3] It may be arguable whether p = .085 should be considered to approach significance, but the interaction between word type and position was significant for the production group with the /e/ vowel (p = .040), and it approached significance for the perception group with the /e/ vowel (p = .065) and for the production group with the /o/ vowel (p = .058). An examination of the data clearly reveals a trend in which medial vowels in nonce words specifically were diphthongized less, and the fact that p = .085 provides statistical support for this trend with the perception group's performance on the /o/ vowel.

Based on the initial analyses of the data and on a visual examination of Figures 3-1 and 3-2 (copied as Figures 3-3 and 3-4), I argued in Chapter 3 that learners *probably* solidify less accurate pronunciations for words learned early, thus making it more difficult for them to improve their pronunciation of those words later. This conclusion is not completely supported by the statistical analyses in Chapter 3, however, because no main effect of word type was found for the /o/ vowel in the original analyses. Analyzing the data more closely by separating target medial vowels from target final vowels allows for a more thorough understanding of the nature of diphthongization in this study. The primary observation made from these deeper analyses is that final vowels were consistently diphthongized more than medial vowels and that vowels diphthongized least of all were medial vowels in nonce words.

The results of the ANOVAs presented in 4.3.2 above suggest that specifically when vowels were in medial position, they were diphthongized less in nonce words than in real words. To provide further support for this finding, 2 (test: pre and post) x 2 (word type: real and nonce) Factorial Repeated Measures ANOVAs were carried out on data collected solely from the target vowels in medial position. These tests were conducted for each group (production and perception) and each vowel (/e/ and /o/) separately, yielding four total tests: 1) the /e/ vowel for the production group, 2) the /o/ vowel for the production group, 3) the /e/ vowel for the perception group, and 4) the /o/ vowel for the perception group. It was expected that these tests would reveal significantly less diphthongization of the mid vowels in nonce words vis-à-vis real words. When considering only the data collected from the medial vowels, 2 (test: pre, post) x 2 (word type: real, nonce) ANOVAS reveal a main effect of word type in all cases except for the perception group with the /o/ vowel. See Table 4-5 below for these results.

Table 4-5. Statistical results for a main effect of word type with only medial vowels.

Group	Vowel	F value	Error df	p value
Production	/o/	9.208	55	.004*
	/e/	9.177	57	.004*
Perception	/o/	2.941	48	.093
	/e/	9.294	46	.004*

Note: F values, degrees of freedom, and p values are shown for each vowel within each group. *Significant effect at the level of $p < .01$.

It can be seen in Table 4-4 and Figure 4-4 above that for the /o/ vowel in medial conditions, the perception group improved so much in their diphthongization of the vowel that there was practically no difference during the posttest between real (mean = 11.00 Hz) and nonce (mean = 9.90 Hz) words. It is for this reason that no main effect of word type is found for the perception group with the /o/ vowel (see Table 4-5). When comparing the perception group's performance with the /o/ vowel in medial conditions on the pretest alone using a one-way ANOVA, a significant effect is then found for word type ($F_{1,48} = 5.717$, $p = .021$).

The analyses performed and discussed in this section suggest that the primary predictor of diphthongization in this study was whether the target vowel was in medial or final position. The secondary predictor of diphthongization, then, was whether the vowel was in a real word or nonce word. It appears from these results that the tendency in English to lengthen syllables at the end of an intonational phrase may be one of the more difficult aspects of L1 English phonology to change in the developing L2 phonological grammar. It appears to be so difficult that learners continue to diphthongize vowels in both real and nonce words to high degrees when these vowels are in intonational-phrase-final position, which corresponds to word-final position in this study

(because all stimulus items were single words). It seems, then, that as learners improve their pronunciation, they do, in fact, exhibit better L2 pronunciation on newly learned words or words they do not know relative to words learned early. However, this superior pronunciation with newly learned or unknown words is attenuated (or disappears) for vowels in intonational-phrase-final position, because L1 English learners of L2 Spanish continue to lengthen, and thus diphthongize, these vowels to high degrees in their developing L2 phonology.

4.4 Insights from the quantification of diphthongization

Diphthongization of the vowels /e/ and /o/ was quantified and measured in this study to gain deeper insight into students' improvement in the production of these vowels. How does quantification of diphthongization relate to the frequency of accurate vowel articulations? To better understand what the average diphthongization of these vowels represents about participants' performance, data showing the percentage of productions that were or were not target like should be viewed. Figures 4-5 through 4-8 below show histograms of the participants' productions of /e/ and /o/ in this study.

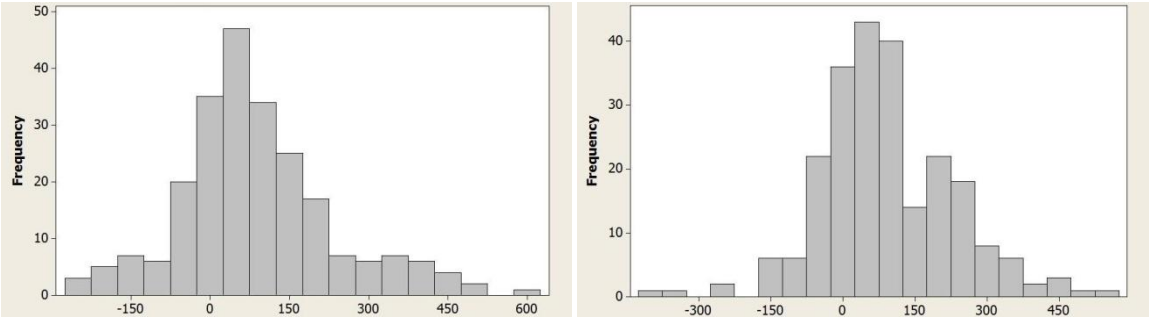


Figure 4-5. Histograms of the production group's /e/ vowels.
Pretest performance is on the left, and posttest on the right. Frequency of occurrence is on the y-axis and ranges for the change in F2-F1 in hertz are on the x-axis. Ranges along the x-axis are separated into divisions of 50 Hz. For example, the division including 0 Hz ranges from -25 Hz to 25 Hz. Positive values indicate diphthongization because F2-F1 increases in diphthongized /e/ vowels.

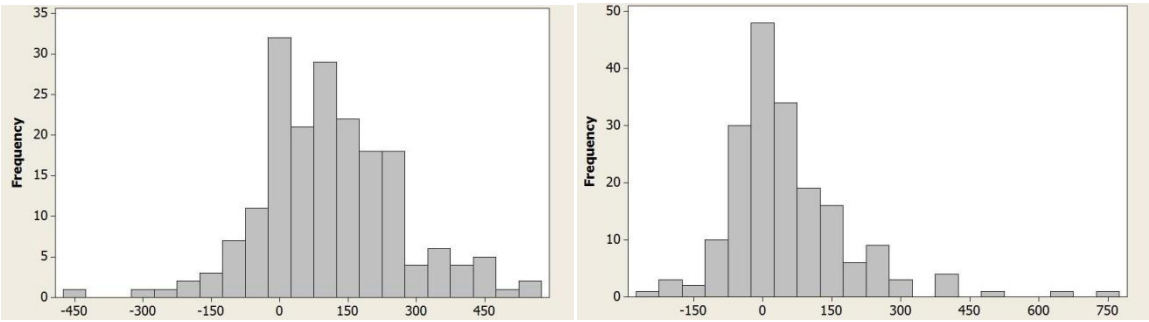


Figure 4-6. Histograms of the perception group's /e/ vowels.
Pretest performance is on the left, and posttest on the right. Frequency of occurrence is on the y-axis and ranges for the change in F2-F1 in hertz are on the x-axis. Ranges along the x-axis are separated into divisions of 50 Hz. For example, the division including 0 Hz ranges from -25 Hz to 25 Hz. Positive values indicate diphthongization because F2-F1 increases in diphthongized /e/ vowels.

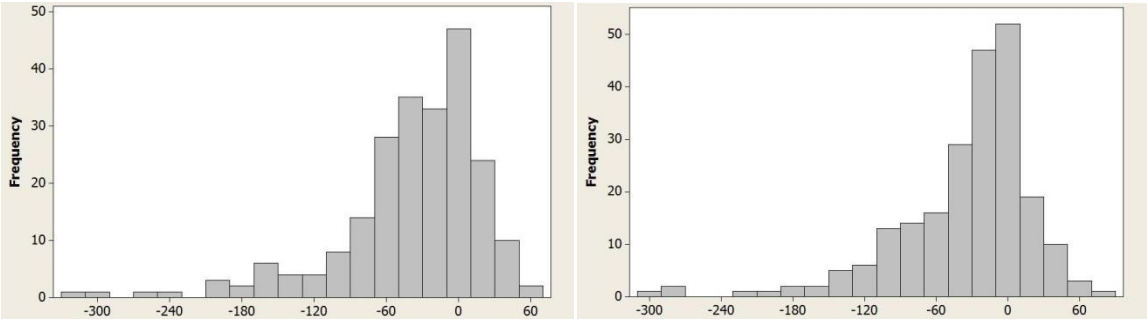


Figure 4-7. Histograms of the production group's /o/ vowels.
Pretest performance is on the left, and posttest on the right. Frequency of occurrence is on the y-axis and ranges for the change in F1 in hertz are on the x-axis. Ranges along the x-axis are separated into divisions of 20 Hz. For example, the division including 0 Hz ranges from -10 Hz to 10 Hz. Negative values indicate diphthongization because F1 decreases in diphthongized /o/ vowels.

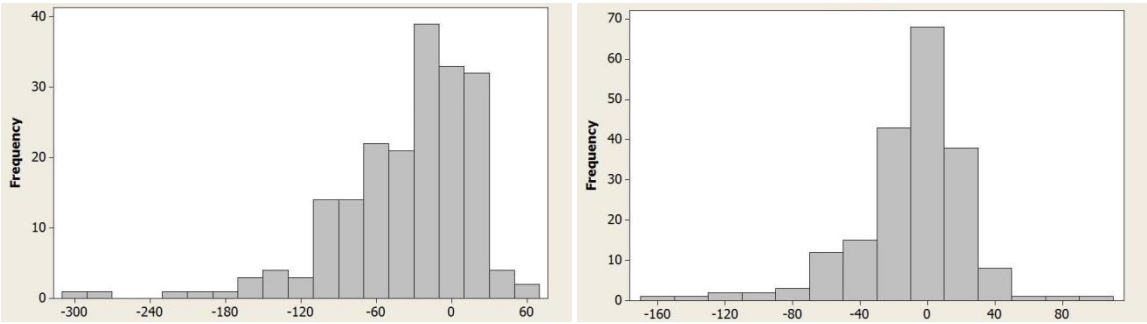


Figure 4-8. Histograms of the perception group's /o/ vowels.
Pretest performance is on the left, and posttest on the right. Frequency of occurrence is on the y-axis and ranges for the change in F1 in hertz are on the x-axis. Ranges along the x-axis are separated into divisions of 20 Hz. For example, the division including 0 Hz ranges from -10 Hz to 10 Hz. Negative values indicate diphthongization because F1 decreases in diphthongized /o/ vowels.

One observation to be made from the histograms in Figures 4-5 through 4-8 is that many productions of the vowels were diphthongized to intermediate degrees. This is seen in the fact that while the degree of diphthongization (change in F2-F1 for /e/ vowels and change in F1 for /o/ vowels) of most vowel productions was near zero, for many productions, the degree of

diphthongization gradually and subtly deviated from zero. If vowel productions were always either accurately L2-like or erroneously L1-like, a bimodal distribution would be expected for all graphs in Figures 4-5 through 4-8, but all graphs in these figures illustrate a unimodal distribution. Another observation to be made is that, in line with results already shown, the histograms illustrate that the perception group articulated more vowels with little change in F1 (/o/ vowel) or F2-F1 (/e/ vowel) on the posttest compared to the pretest. For example, in Figure 4-6, the quantity of productions of the /e/ vowel that exhibited a change in F2-F1 falling in the range of -25 Hz to 25 Hz (the bar above 0 on the x-axis) increased from less than 35 on the pretest to nearly 50 on the posttest. Likewise, in Figure 4-8, the number of productions of the /o/ vowel with a change in F1 falling in the range of -10 Hz to 10 Hz (the bar above 0 on the x-axis) increased from less than 40 on the pretest to nearly 70 on the posttest. The frequency of vowels falling within these ranges of diphthongization, therefore, coincides with the average degree of diphthongization as reported in Chapter 3.

To further examine the relationship between the frequency of accurate mid vowel productions and the average degree of diphthongization of the mid vowels, percentages of accurate articulations of /e/ and /o/ were calculated for each group on both the pretest and posttest. Productions of /o/ were considered accurate if the drop in F1 was less than 10 Hz, and productions of /e/ were considered accurate if the increase in F2-F1 was less than 40 Hz. These cutoffs were chosen arbitrarily because no previous research has performed similar analyses. In theory, the appropriate cutoffs should be points at which native listeners would begin to detect diphthongization of the vowels. See Table 4-6 below for the percentages of accurate productions for each group on each test.

Table 4-6. Percentage of accurate productions of /e/ and /o/.

Group	Vowel	Pretest	Posttest	Improvement
Production	/o/	35.9%	37.6%	no
	/e/	34.3%	34.7%	no
Perception	/o/	34.2%	59.8%	yes*
	/e/	32.2%	50.8%	yes*

Note: Accurate productions of /e/ and /o/ on the pretest and posttest are shown for each group.
*p < .001 as calculated on a paired-samples t-test.

It can be seen in Table 4-6 that roughly one-third of all productions on the pretest were considered accurate, but while the production group did not increase this percentage significantly on the posttest, the perception group did. Nearly 60% of productions of /o/ and nearly 51% of productions of /e/ were considered accurate for the perception group on the posttest.

Two important insights have been gained by comparing the average degree of diphthongization calculated earlier (see Chapter 3 and Section 4.3.2 above) with the histograms in Figures 4-5 through 4-8 and the percentages in Table 4-6. One of these is that English learners of Spanish do not always articulate a perfectly Spanish or perfectly English mid vowel, but rather they often articulate mid vowels exhibiting degrees of diphthongization between those degrees expected for the Spanish and English mid vowels (i.e. they exhibit intermediate degrees of diphthongiation). The other important insight gained here is that learners of Spanish do produce many mid vowels with little to no diphthongization. In this study, participants exhibiting the most improvement in the production of these vowels produced a significantly higher percentage of their mid vowels as monophthongs (i.e. accurately) on the posttest (inasmuch as accuracy or *monophthongization* was operationalized in this section).

4.5 Implications for second language pedagogy

There are two primary implications of the results of this study for second language pedagogy. One is that it is possible to direct students' attention to differences in L1 and L2 sounds in a way that leads to pronunciation improvement. The other is that it may be best to direct students' attention to these phonetic differences early in an L2 curriculum. Each of these primary implications is discussed in further detail in the sections that follow.

4.5.1 Directing students' attention to L2 sounds

In addition to supporting previous findings that pedagogical techniques can lead to improvement in pronunciation (Derwing et al., 1998; Elliott, 1995b, 1997; Lord, 2005), the findings of this study make two important suggestions regarding attention in SLA. Similar to findings on the role of attention in learning morphosyntactic forms (Cadierno, 1995; VanPatten and Cadierno, 1993a, 1993b; VanPatten and Wong, 2004), these findings suggest that attention plays a role in the learning of L2 speech sounds. In addition, they suggest that it is possible to create pronunciation assignments that adequately direct students' attention to L2 phonetics. The findings of this study imply that whether pronunciation assignments are based on perception or production, they should at least be designed by considering how they direct students' attention to L2 phonetics.

As discussed in Chapter 1, parallels can be drawn between this study and findings on Processing Instruction. Several studies (Cadierno, 1995; Van Patten and Cadierno, 1993a, 1993b; VanPatten and Wong, 2004) have found that directing students' attention to grammatical forms of interest leads to improvement in the use of those forms. Moreover, these studies have found that students' attention can be directed to target grammatical forms during input activities in such a

way that students improve in their production of the target grammatical forms even without production practice. The findings in this dissertation are comparable to the findings of these previous studies in that the assignment that directed students' attention to pronunciation and led to pronunciation improvement required students to listen to L2 sounds but not produce them. As stated above, pronunciation assignments should be designed by considering how they direct students' attention to L2 phonetics. The findings in this dissertation imply that designing assignments that require students to listen to L2 sounds may be more effective at directing students' attention to L2 phonetics than assignments that only require students to produce L2 speech sounds. Similarly to arguments made for Processing Instruction (Sanz and VanPatten, 1998), this does not imply that producing target L2 sounds is superfluous and plays no role in pronunciation improvement, but rather that listening to L2 speech sounds may be a crucial first step that should not be ignored or skipped.

4.5.2 Earlier is better

Results from this study suggest that, except for vowels in intonational-phrase-final position (which is word-final position in this study), vowels were diphthongized less in nonce words than in real words (see 4.3 above for discussion). It was mentioned earlier that the real words in this study represent words that participants learned early and have heard or used often, and the nonce words represent Spanish words that have either recently been learned or that the learner encounters for the first time. These findings suggest that as SLLs establish lexical entries for the words they learn, they may solidify pronunciations associated with those lexical entries. It is possible that establishing a heavily accented pronunciation for early-acquired lexical entries leads to difficulty in altering that pronunciation at a later time. This implies that pronunciation

instruction, as well as effective and efficient pronunciation assignments, should be administered to students as early as possible in an L2 curriculum.

4.6 Questions for future research

There are several questions raised by the findings in this study that motivate further research. Two of them relate to the extension of the design used in this study to include not just single words as target stimuli but also full sentences. Firstly, do the results obtained in this study at the single-word level carry over to sentence-level speech? If after only one semester of the type of pronunciation practice used in this study, students must consciously direct attention to their pronunciation in order to articulate more target-like vowels, then the improvement found in this study may disappear at sentence-level productions. If, on the other hand, the improvement observed in this study has already become part of procedural knowledge after only one semester, it is expected that participants would show similar improvement when reading full sentences. Therefore, in addition to replicating the design of this study, future research should also imbed target words into full sentence contexts. This would allow comparisons between single-word and full-sentence conditions, which would shed light on the level of automaticity reached (or not reached) in the production of these vowels.

Another question that arises with the notion of comparing single words to full sentences is whether participants would exhibit less diphthongization with final unstressed vowels than was found in this study if they read full sentences? Given that English speakers lengthen syllables at the end of intonational phrases, which led to greater diphthongization in word-final position in this study, it is expected that participants would not lengthen the final syllables of the target words used in this study if they were imbedded in full sentences (and if each sentence only contained one intonational phrase). If this is the case, upon reading full sentences, the result

found here that final unstressed vowels were diphthongized more should disappear. We may also expect to find that all vowels, stressed or unstressed, would be diphthongized more in real words learned early than in nonce words. To achieve an accurate answer to this question, future research that incorporates full sentences in the stimulus set should be careful to imbed target words in locations within full sentences that are not intonational-phrase-final. Furthermore, target words should appear in roughly the same location within each full sentence to eliminate other possible suprasegmental (i.e., rhythmic) effects.

Another important question that remains for future research is whether the results found in this dissertation for the vowels /e/ and /o/ extend to other sounds? Results from this study suggest that the perception assignment, which was designed to focus students' attention on L2 pronunciation, leads to improvement in the articulation of the vowels /e/ and /o/. If the interpretation of this finding is accurate, then similar improvement should be found for other sounds, such as the consonants /p, t, k, b, d, g, l/. Therefore, the present study should be replicated in a way that includes these additional sounds in the stimulus set so that improvement with these sounds can be compared between the perception and production groups.

In summary, this dissertation has made connections with other aspects of SLA research that most recent research on L2 pronunciation has failed to make. Parallels have been drawn between the present study and studies investigating the impact of Processing Instruction on the learning of morphosyntactic aspects of L2 grammar. Findings suggest that, similarly to findings from studies on Processing Instruction, assignments that direct students' attention to the fine-grained details of L2 speech sounds, which students would arguably not attend to otherwise, leads to improvement in the production of those L2 speech sounds. Furthermore, as discussed above, this dissertation has opened doors to questions for future research, the investigation of which should lead to an increased understanding of ways to help students improve their L2 pronunciation.

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Appendix A

Language Experience and Proficiency Questionnaire

Northwestern Bilingualism & Psycholinguistics Research Laboratory

Please cite Marian, Blumenfeld, & Kaushanskaya (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech Language and Hearing Research, 50* (4), 940-967.

Language Experience and Proficiency Questionnaire (LEAP-Q)

Last Name		First Name		Today's Date	
Age		Date of Birth		Male ☐	Female ☐

(1) Please list all the languages you know **in order of dominance**:

1	**2**	**3**	**4**	**5**

(2) Please list all the languages you know **in order of acquisition** (your native language first):

1	**2**	**3**	**4**	**5**

(3) Please list what percentage of the time you are *currently* and *on average* exposed to each language.

(*Your percentages should add up to 100%*):

List language here:					
List percentage here:					

(4) When choosing to read a text available in all your languages, in what percentage of cases would you choose to read it in each of your languages? Assume that the original was written in another language, which is unknown to you.

(*Your percentages should add up to 100%*):

List language here					
List percentage here:					

(5) When choosing a language to speak with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report percent of total time.

(*Your percentages should add up to 100%*):

List language here					
List percentage here:					

(6) Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to which you identify with each culture. (Examples of possible cultures include US-American, Chinese, Jewish-Orthodox, etc):

List cultures here					
	(click here for scal	(click here for scal	(click here for scal	(click here for scal	(click here for scal

(7) How many years of formal education do you have? _____ _____

Please check your highest education level (or the approximate US equivalent to a degree obtained in another country):

☐ Less than High School ☐ Some College ☐ Masters

☐ High School ☐ College ☐ Ph.D./M.D./J.D.

☐ Professional Training ☐ Some Graduate School ☐ Other:

(8) Date of immigration to the USA, if applicable ___ _____

If you have ever immigrated to another country, please provide name of country and date of immigration.

_____ _____

(9) Have you ever had a vision problem ☐, hearing impairment ☐, language disability ☐, or learning disability ☐ ? (Check all applicable). If yes, please explain (including any corrections):

_____ _____

Language:

This is my (please select from pull-down menu) language.

All questions below refer to your knowledge of .

(1) Age when you…:

began acquiring	*became fluent*	*began reading*	*became fluent reading*
:	in :	in :	in :

(2) Please list the number of years and months you spent in each language environment:

	Years	Months
A country where is spoken		
A family where is spoken		
A school and/or working environment where is spoken		

(3) On a scale from zero to ten, please select your *level of* ***proficiency*** in speaking, understanding, and reading from the scroll-down menus:

Speaking	(click here for scal	Understanding spoken language	(click here for scale)	Reading	(click here for scal

(4) On a scale from zero to ten, please select how much the following factors contributed to you

learning :

Interacting with friends	(click here for pull-down scale	Language tapes/self instructi	(click here for pull-down scal
Interacting with family	(click here for pull-down scale	Watching TV	(click here for pull-down scal
Reading	(click here for pull-down scale	Listening to the radio	(click here for pull-down scal

(5) Please rate to what extent you are currently exposed to in the following contexts:

Interacting with friends	(click here for pull-down scale	Listening to radio/music	(click here for pull-down scal
Interacting with family	(click here for pull-down scale	Reading	(click here for pull-down scal
Watching TV	(click here for pull-down scale	Language-lab/self-instruction	(click here for pull-down scal

(6) In your perception, how much of a foreign accent do you have in ?

(click here for pull-down scale)

(7) Please rate how frequently others identify you as a non-native speaker based on your accent in :

(click here for pull-down scale)

Language:

This is my (please select from pull-down menu) language.

All questions below refer to your knowledge of .

(1) Age when you…:

began acquiring	*became fluent*	*began reading*	*became fluent reading*
:	in :	in :	in :

(2) Please list the number of years and months you spent in each language environment:

	Years	Months
A country where is spoken		
A family where is spoken		
A school and/or working environment where is spoken		

(3) On a scale from zero to ten please select your *level of* ***proficiency*** in speaking, understanding, and reading from the scroll-down menus:

Speaking	(click here for scale)	Understanding spoken language	(click here for scale)	Readin g	(click here for scal

(4) On a scale from zero to ten, please select how much the following factors contributed to you learning :

Interacting with friends	(click here for pull-down scale)	Language tapes/self instruction	(click here for pull-down scal
Interacting with family	(click here for pull-down scale)	Watching TV	(click here for pull-down scal
Reading	(click here for pull-down scale)	Listening to the radio	(click here for pull-down scal

(5) Please rate to what extent you are currently exposed to in the following contexts:

Interacting with friends	(click here for pull-down scale)	Listening to radio/music	(click here for pull-down scal
Interacting with family	(click here for pull-down scale)	Reading	(click here for pull-down scal
Watching TV	(click here for pull-down scale)	Language-lab/self-instruction	(click here for pull-down scal

(6) In your perception, how much of a foreign accent do you have in ?

(click here for pull-down scale)

(7) Please rate how frequently others identify you as a non-native speaker based on your accent in :

(click here for pull-down scale)

Appendix B

Boston Naming Test Words

The words that describe the 60 pictures presented in the Boston Naming Test are provided in English and Spanish below.

1.	bed	cama
2.	tree	árbol
3.	pencil	lápiz
4.	house	casa
5.	whistle	silbato
6.	scissors	tijeras
7.	comb	peine
8.	flower	flor
9.	saw	sierra
10.	toothbrush	cepillo de dientes
11.	helicopter	helicóptero
12.	broom	escoba
13.	octopus	pulpo
14.	mushroom	hongo, seta, champiñón
15.	hanger	gancho, percha
16.	wheelchair	silla de ruedas
17.	camel	camello
18.	mask	máscara
19.	pretzel	pretzel
20.	bench	banco
21.	racquet	raqueta
22.	snail	caracol
23.	volcano	volcán
24.	seahorse	caballito del mar
25.	dart	dardo
26.	canoe	canoa
27.	globe	globo (terráqueo)
28.	wreath	corona
29.	beaver	castor
30.	harmonica	armónica
31.	rhinoceros	rinoceronte
32.	acorn	bellota
33.	igloo	iglú
34.	stilts	zancos
35.	dominoes	dominó
36.	cactus	cacto, cactus

37.	escalator	escalera mecánica
38.	harp	arpa
39.	hammock	hamaca
40.	knocker	aldaba, llamador
41.	pelican	pelícano
42.	stethoscope	estetoscopio
43.	pyramid	pirámide
44.	muzzle	bozal
45.	unicorn	unicornio
46.	funnel	embudo
47.	accordion	acordeón
48.	noose	lazo
49.	asparagus	espárrago
50.	compass	compás
51.	latch	pestillo
52.	tripod	trípode
53.	scroll	rollo, pergamino
54.	tongs	pinzas
55.	sphinx	esfinge
56.	yoke	yugo
57.	trellis	enrejado, espaldera
58.	palette	paleta
59.	protractor	transportador
60.	abacus	ábaco

Appendix C

Grammar Proficiency Test

PARTE UNO **NOMBRE** _____

Escoger la respuesta más apropiada

1. ¿Qué _____ Uds.?
A. hacéis B. hago C. hacen D. haces

2. Rosa y Miguel van _____ cine.
A. al B. de la C. del D. a la

3. Yo _____ el hermano de Pepe.
A. eres B. soy C. estoy D. es

4. Hace un año que trabajo en _____ fábrica.
A. esto B. esta C. ese D. este

5. Tomás dijo que _____ a correos pero no tiene tiempo.
A. va B. iría C. iba D. ir

6. ¿Dónde vivían los aztecas a _____ venció Cortés?
A. quienes B. que C. los cuales D. quien

7. Juan quiere que _____ temprano.
A. llegan B. llegaron C. llegar D. lleguen

8. Las niñas _____ jugando en la calle.
A. son B. somos C. están D. está

9. El otro día yo _____ Tomás.
A. veía B. vi a C. viste D. vieron

10. Ayer _____ buen tiempo.
A. era B. hacía C. había D. estaba

11. Era probable que él lo _____ .
A. tenga B. tuvo C. tenía D. tuviera

12. Todas mis amigas _____ a la fiesta por Marcos.
A. han sido invitadas B. han sido invitado C. están invitado D. son invitadas

13. Rosa me _____ ayer.
A. visitasteis B. visité C. visitaste D. visitó

14. Pepe toca _____ guitarra.
A. los B. la C. lo D. el

15. ¡ _____ Uds.!
A. Se levanten B. Levántense C. Levántanse D. Levántese

PARTE DOS

En cada frase, escoger la palabra subrayada que es incorrecta.

1. Ayer yo ella escribí una carta.
A. Ayer B. ella C. una D. carta

2. El campesino venden frutas.
A. El B. campesino C. venden D. frutas

3. Dirigimos uno negocio importante.
A. Dirigimos B. uno C. negocio D. importante

4. Poco a poco los estudiantes van aprendendo.
A. a B. los C. van D. aprendendo

5. Ellos fueron al teatro los sábados.
A. Ellos B. fueron C. los D. sábados

6. El médico era un hombre dedicaba a la numismática.
A. era B. dedicaba C. a D. la

7. ¿Saludan Uds. al profesor al entra en la clase?
A. Saludan B. Uds. C. al D. entra

8. ¿Quien las va a arreglar?
A. Quien B. las C. va D. a

9. Pagó diez dólares para el libro.
A. Pagó B. dólares C. para D. el

10. Le lo dijo hace mucho tiempo.
A. Le B. lo C. dijo D. hace

11. ¿De dónde viene todo esto ruido?
A. dónde B. viene C. todo D. esto

12. Si tenía mucho dinero, me compraría un coche nuevo.
A. tenía B. me C. compraría D. un

13. Mañana por la mañana he terminado con mi trabajo.
A. por B. he C. terminado D. mi

14. Andrés no quiso discutir y le fue a Madrid.
A. quiso B. discutir C. le D. a

15. La ciudad fue destruido por el huracán.
A. La B. fue C. destruido D. por

Appendix D

Pronunciation Attitude Inventory

PAI adapted from Elliott, A.R. 1995. *MLJ*, 79, 3, 356-371.

Name: Date:

Please answer items 1 - 10 using the following response categories:
5=Always or almost always true of me
4=Usually true of me
3=Somewhat true of me
2=Usually not true of me
1=Never or almost never true of me

1. I'd like to sound as native as possible when speaking Spanish.
   Answer:
2. Acquiring proper pronunciation in Spanish is important to me.
   Answer:
3. I feel like I will never be able to speak Spanish with a good accent.
   Answer:
4. I believe I can improve my pronunciation skills in Spanish.
   Answer:
5. I believe more emphasis should be given to proper pronunciation in class.
   Answer:
6. I try to imitate Spanish speakers as much as possible.
   Answer:
7. I'm concerned about my accent when I speak Spanish.
   Answer:
7. Communicating is much more important than sounding like a native speaker of Spanish. Answer:
8. Good pronunciation skills in Spanish are not as important as learning vocabulary and grammar. Answer:
10. I do not practice a native-like accent in class because of how other students in class would perceive it. Answer:

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11. Have you studied phonetics or phonology before? Answer:
    If yes, was this general phonetics/phonology or with an emphasis on Spanish? Answer:
12. What is your major?
13. What is the reason for your interest in learning Spanish?

Appendix E

Stimulus Words

Word	Number	Word type	Target/Filler
abeja	1	real	Target
alto	2	real	Target
bastante	3	real	Target
boda	4	real	Target
cabeza	5	real	Target
cansado	6	real	Target
coche	7	real	Target
padre	8	real	Target
paquete	9	real	Target
poco	10	real	Target
todo	11	real	Target
tristeza	12	real	Target
aboche	13	nonce	Target
busado	14	nonce	Target
empere	15	nonce	Target
fogote	16	nonce	Target
mecato	17	nonce	Target
padeso	18	nonce	Target
razote	19	nonce	Target
seneza	20	nonce	Target
tamero	21	nonce	Target
trogosa	22	nonce	Target
sebaca	23	nonce	Filler
gredona	24	nonce	Filler
latiba	25	nonce	Filler
legoba	26	nonce	Filler
cributo	27	nonce	Filler
adaga	28	nonce	Filler
lampiza	29	nonce	Filler
puna	30	nonce	Filler

mazutar	31	nonce	Filler
cufa	32	nonce	Filler
miricar	33	nonce	Filler
medoga	34	nonce	Filler
trada	35	nonce	Filler
setofe	36	nonce	Filler
pate	37	nonce	Filler
tasno	38	nonce	Filler
capre	39	nonce	Filler
aropose	40	nonce	Filler
paltana	41	nonce	Filler
encal	42	nonce	Filler
rapinco	43	nonce	Filler
oltaro	44	nonce	Filler
ancurro	45	nonce	Filler
lupoz	46	nonce	Filler
curtel	47	nonce	Filler
precusa	48	nonce	Filler
esprilto	49	nonce	Filler
mobata	50	nonce	Filler
drebona	51	nonce	Filler
edola	52	nonce	Filler
etompe	53	nonce	Filler
segante	54	nonce	Filler
togol	55	nonce	Filler
yesoga	56	nonce	Filler
rezore	57	nonce	Filler
empezar	58	real	Filler
tocar	59	real	Filler
casa	60	real	Filler
carta	61	real	Filler
pregunta	62	real	Filler
tarde	63	real	Filler
cantar	64	real	Filler
estar	65	real	Filler

agua	66	real	Filler
seguir	67	real	Filler
puerta	68	real	Filler
simpático	69	real	Filler
zapato	70	real	Filler
llegar	71	real	Filler
jugar	72	real	Filler
pagar	73	real	Filler
luego	74	real	Filler
beber	75	real	Filler
escribir	76	real	Filler
trabajo	77	real	Filler
aburrido	78	real	Filler
sábado	79	real	Filler
pedir	80	real	Filler
adentro	81	real	Filler
raro	82	real	Filler
alto	83	real	Filler
almuerzo	84	real	Filler
atacar	85	real	Filler
pájaro	86	real	Filler
cruzar	87	real	Filler
falta	88	real	Filler
mirar	89	real	Filler
botella	90	real	Filler
setenta	91	real	Filler
claro	92	real	Filler
papel	93	real	Filler
cuero	94	real	Filler
ahora	95	real	Filler
romper	96	real	Filler
motocicleta	97	real	Filler
azul	98	real	Filler
volver	99	real	Filler
cómo	100	real	Filler

comida	101	real	Filler
ciudad	102	real	Filler
abajo	103	real	Filler
trigo	104	real	Filler
pecar	105	real	Filler
torre	106	real	Filler
aparecer	107	real	Filler
hogar	108	real	Filler
aguda	109	real	Filler
lobo	110	real	Filler
caja	111	real	Filler
pato	112	real	Filler
locura	113	real	Filler
adivinar	114	real	Filler
arrancar	115	real	Filler
mentira	116	real	Filler
tumba	117	real	Filler
espinas	118	real	Filler
altura	119	real	Filler
deportes	120	real	Filler
ocupar	121	real	Filler
entregar	122	real	Filler
picar	123	real	Filler
bigote	124	real	Filler
lechuga	125	real	Filler
almohada	126	real	Filler
tapar	127	real	Filler
lago	128	real	Filler
saludo	129	real	Filler
alzar	130	real	Filler
pereza	131	real	Filler
habitación	132	real	Filler
sabor	133	real	Filler
matador	134	real	Filler
puerco	135	real	Filler

azar	136	real	Filler
nivel	137	real	Filler
terremoto	138	real	Filler
pared	139	real	Filler
apagar	140	real	Filler
grabación	141	real	Filler
jabón	142	real	Filler
nuboso	143	real	Filler
pastel	144	real	Filler
albergar	145	real	Filler
quizás	146	real	Filler
taza	147	real	Filler
audífono	148	real	Filler
equipo	149	real	Filler

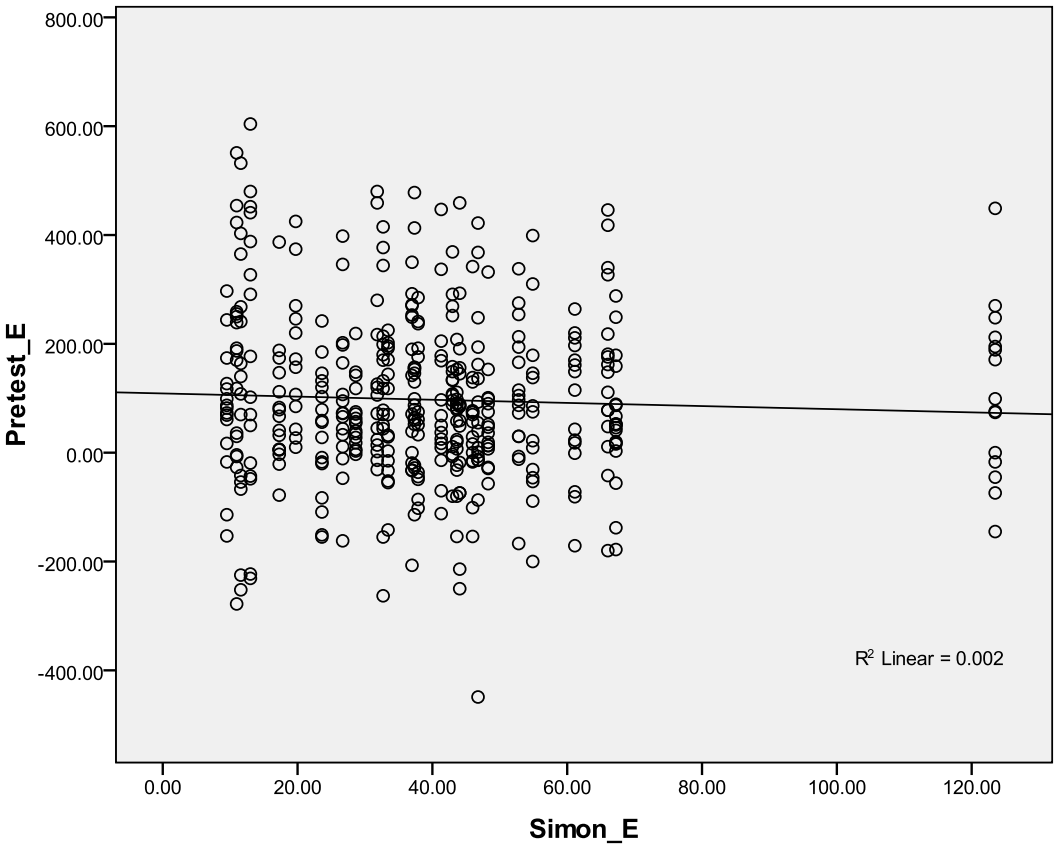
Appendix F

Dot Plots of Correlations between Individual Difference Measures and Performance/Improvement

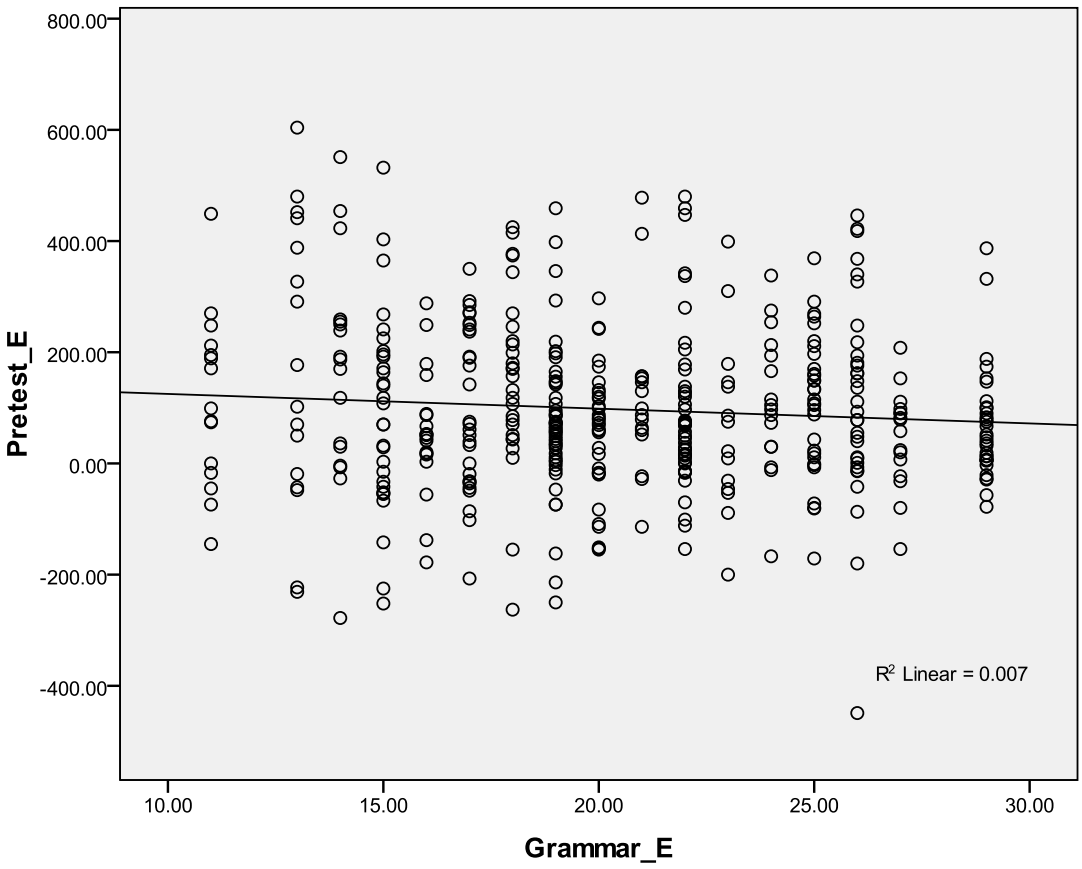
Correlations between pretest performance and individual difference measures

/e/ vowel

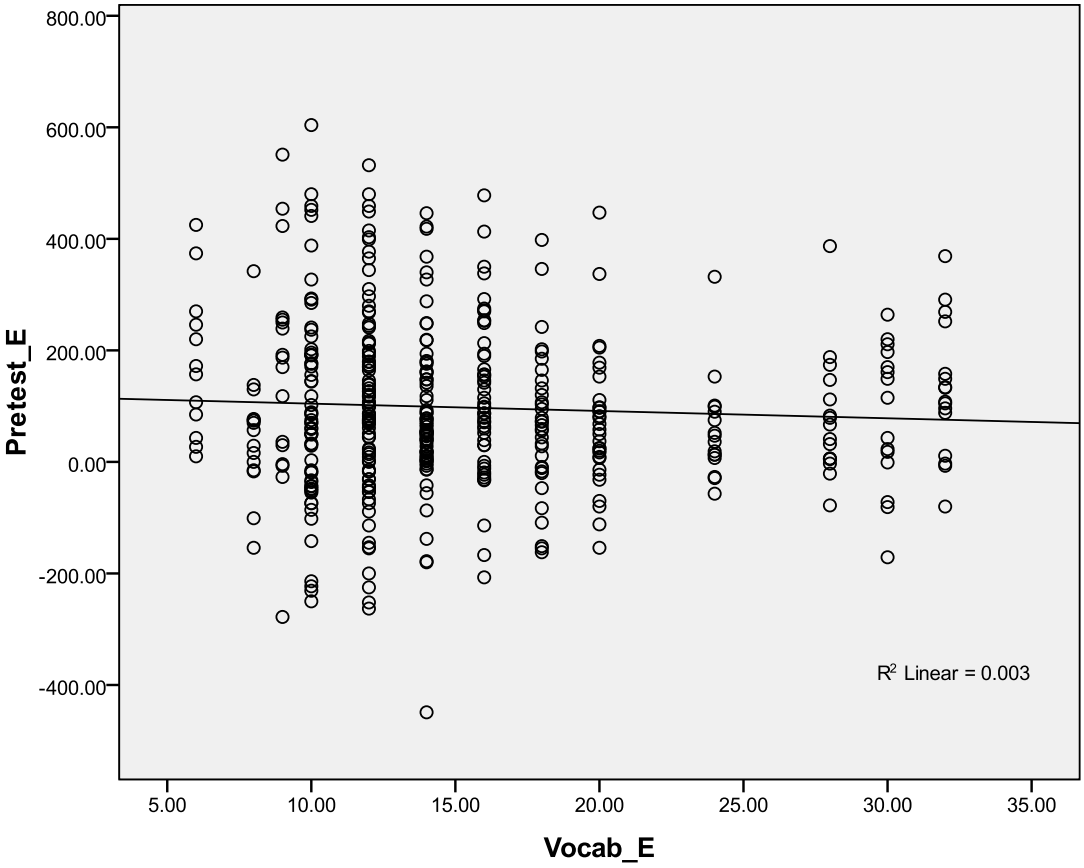
Correlation with Simon score:



Correlation with Grammar proficiency score:

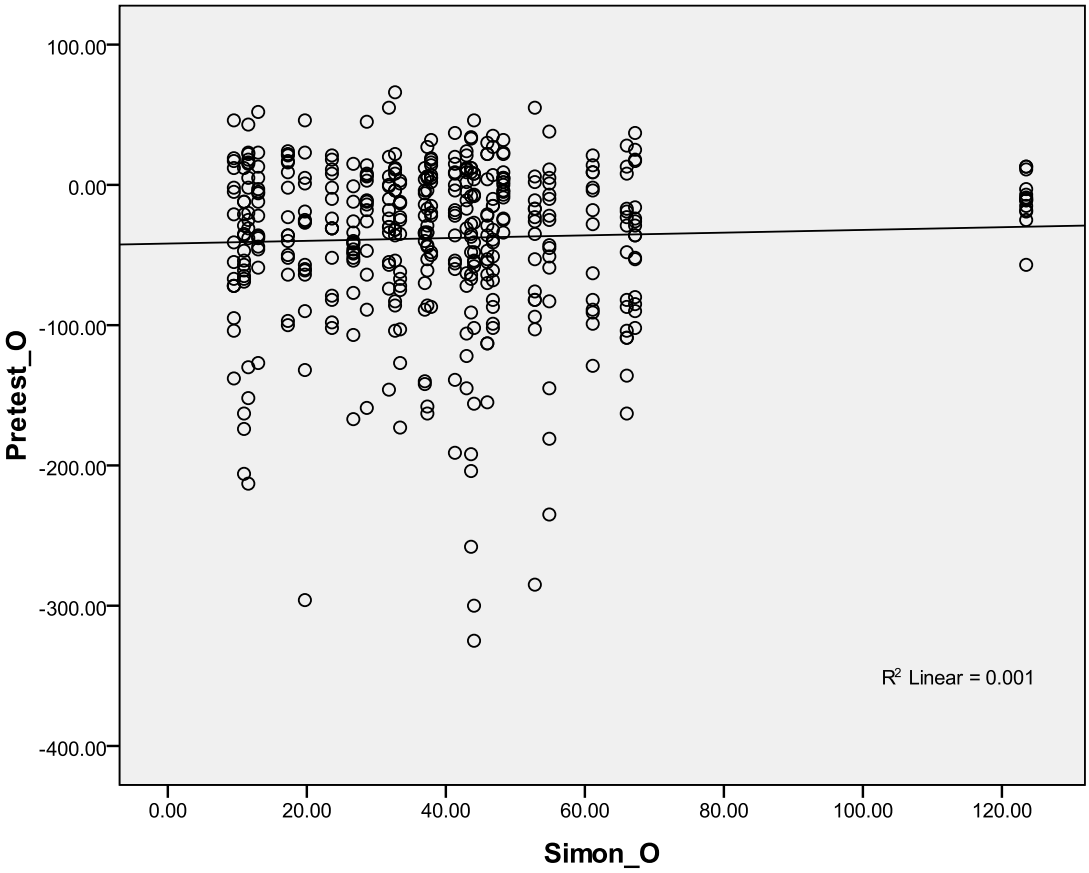


Correlation with Vocabulary proficiency score:

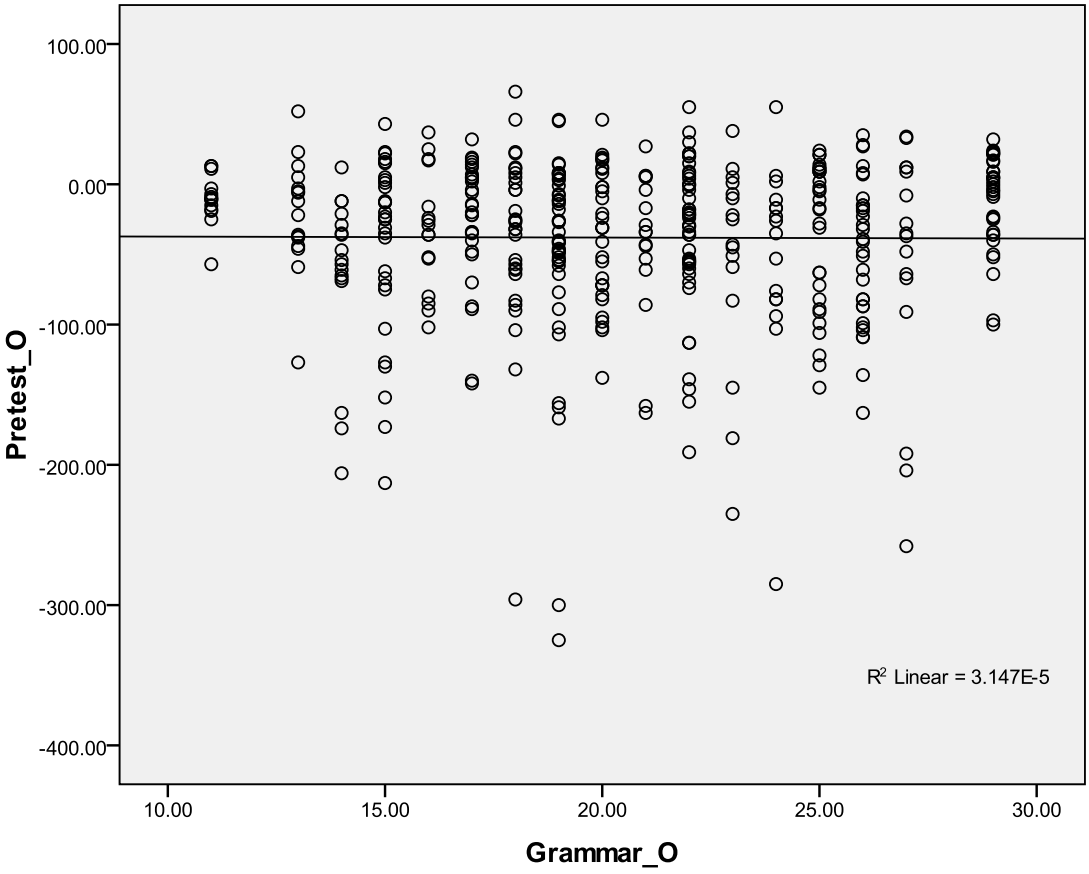


/o/ vowel

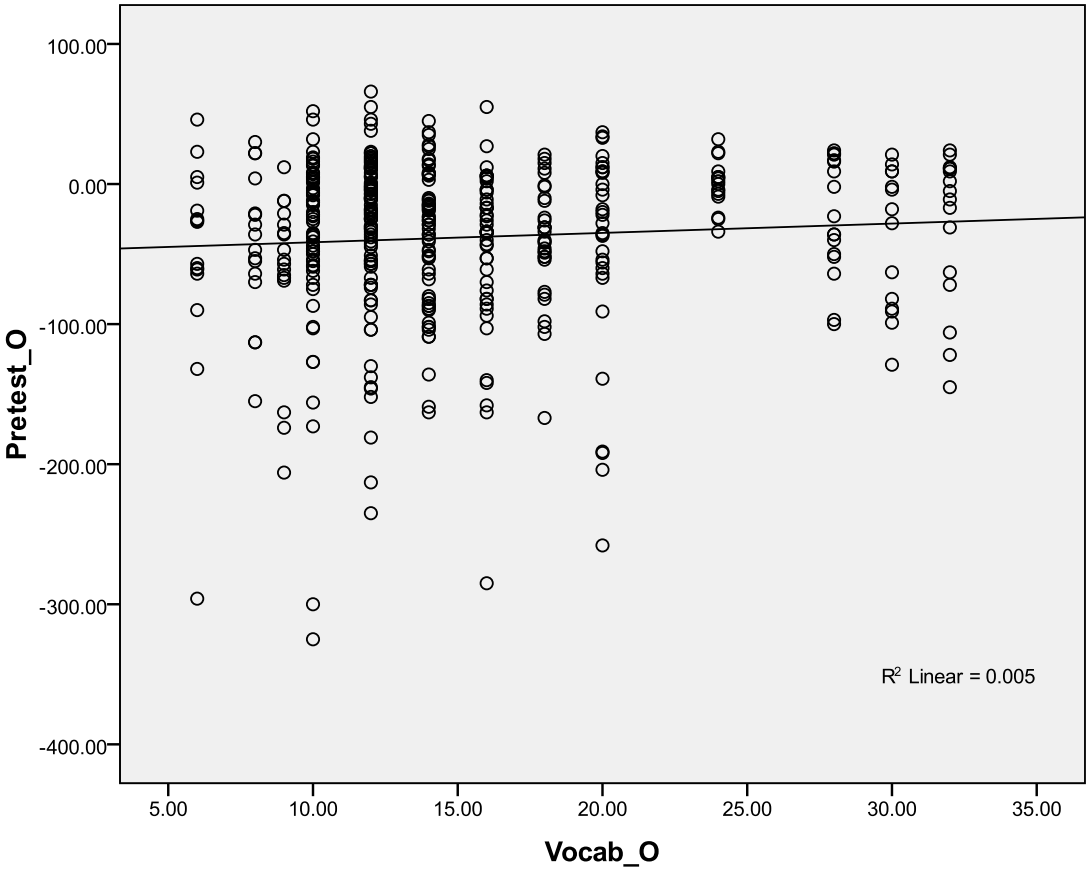
Correlation with Simon score:



Correlation with Grammar proficiency score:



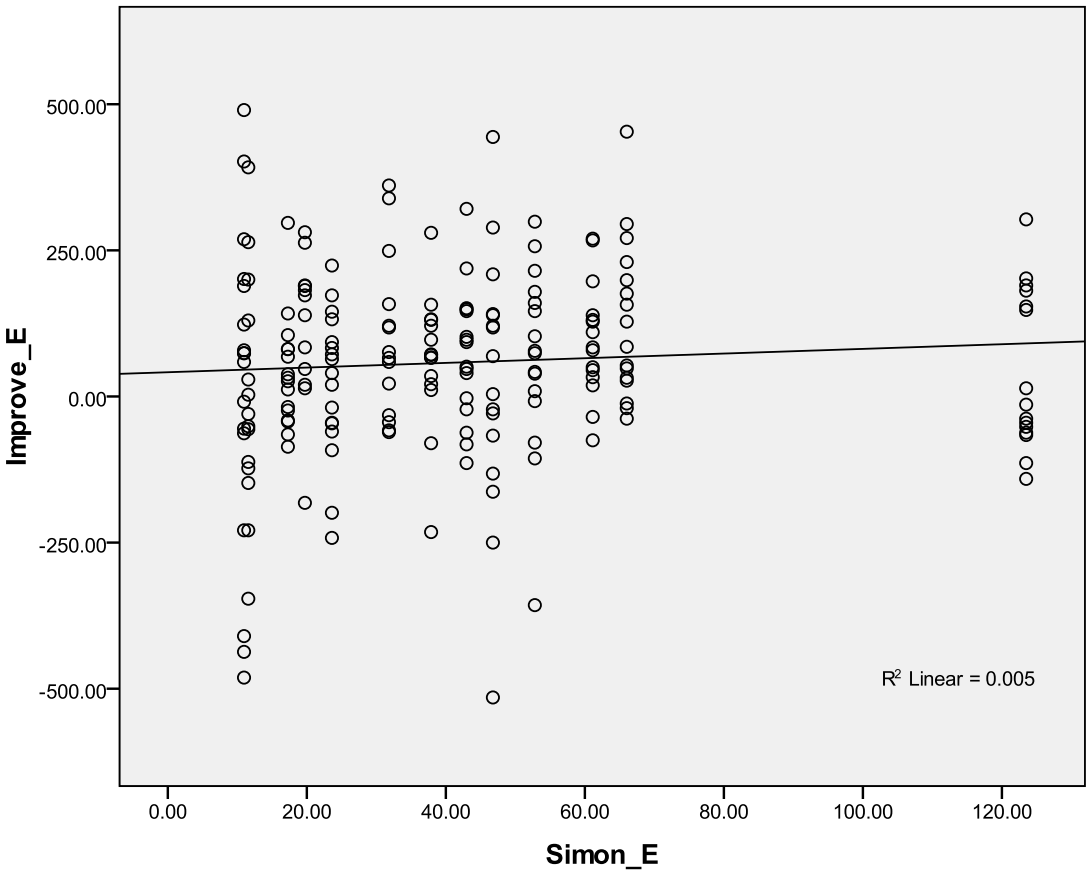
Correlation with Vocabulary proficiency score:



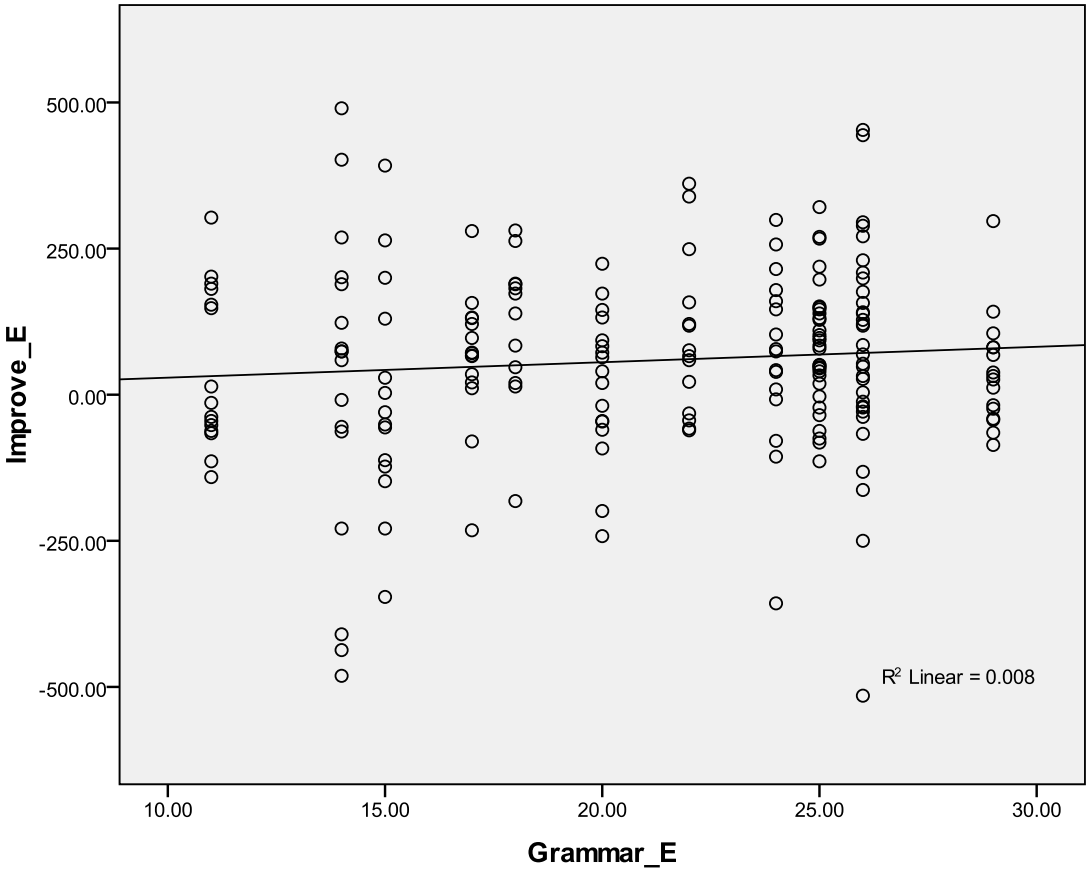
Correlations between improvement* in performance and individual difference measures for the perception group.

*Improvement was measured as the difference in the change in F1 (/o/ vowel) and F2-F1 (/e/ vowel) from the pretest to the posttest.

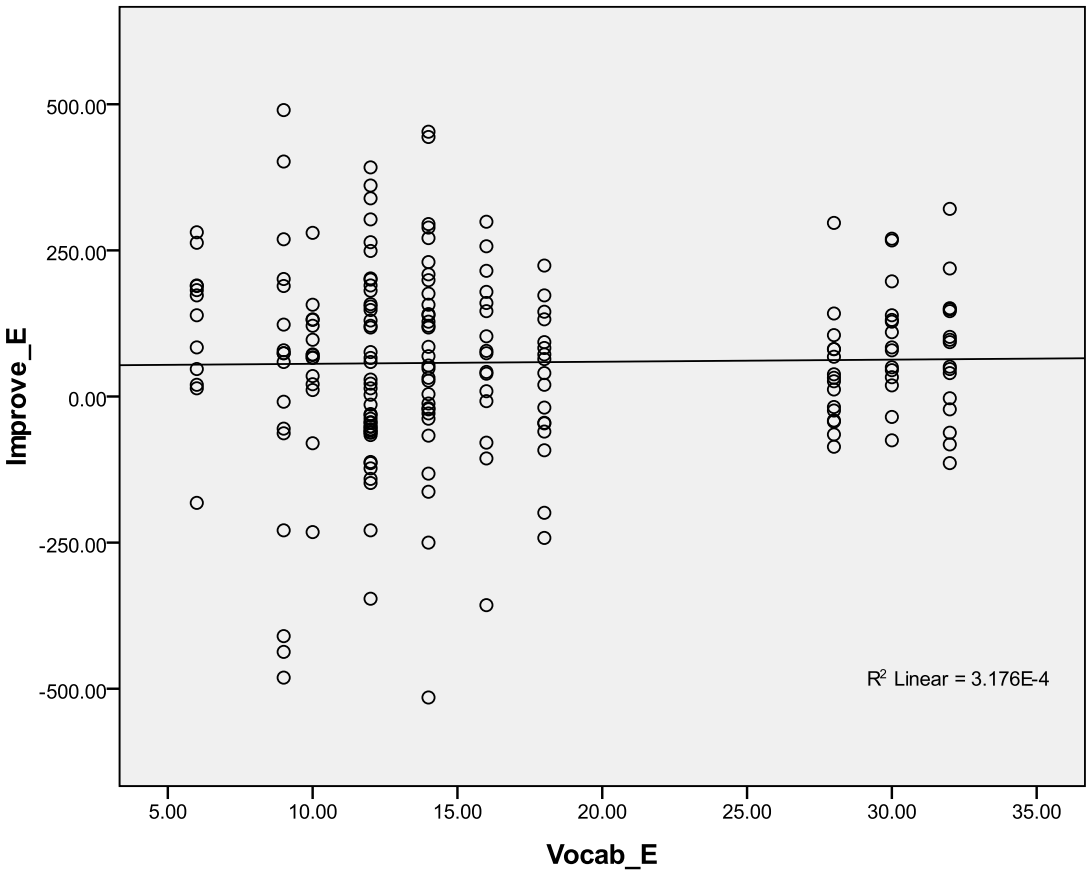
/e/ vowel - Correlation with Simon score:



Correlation with Grammar proficiency score (perception group):

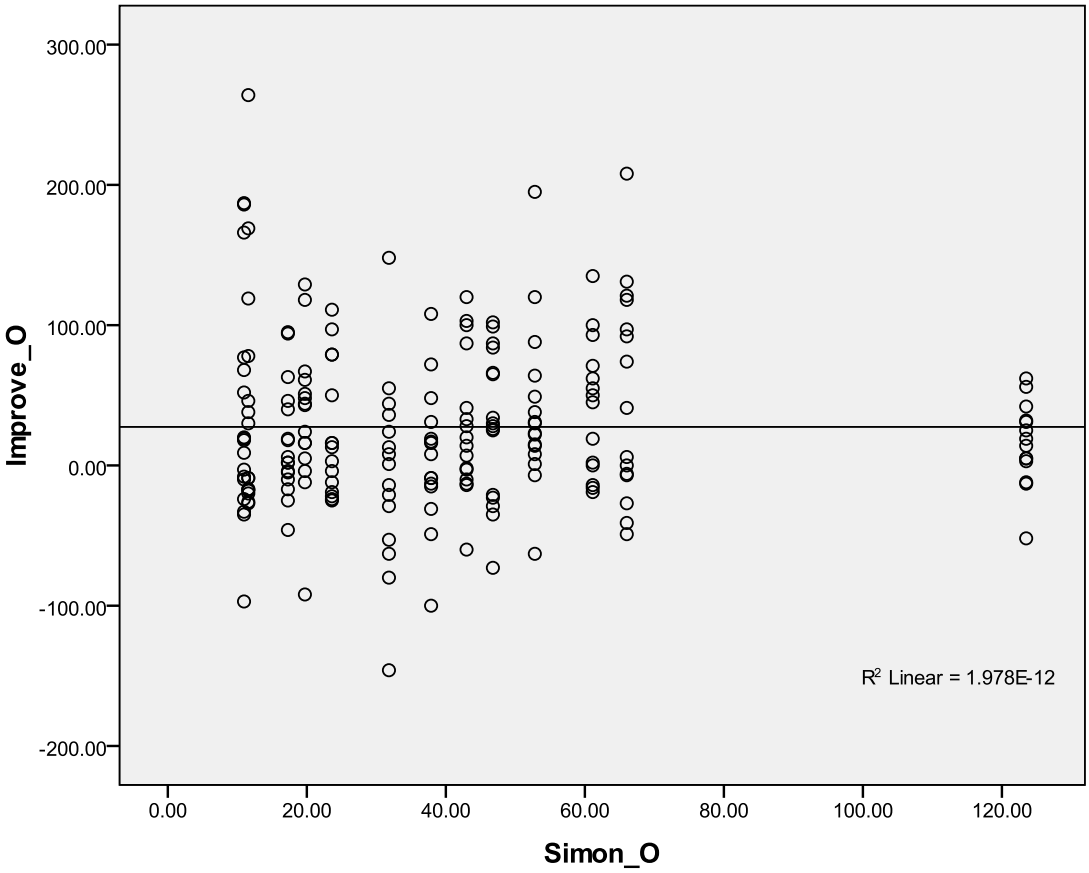


Correlation with Vocabulary proficiency score (perception group):

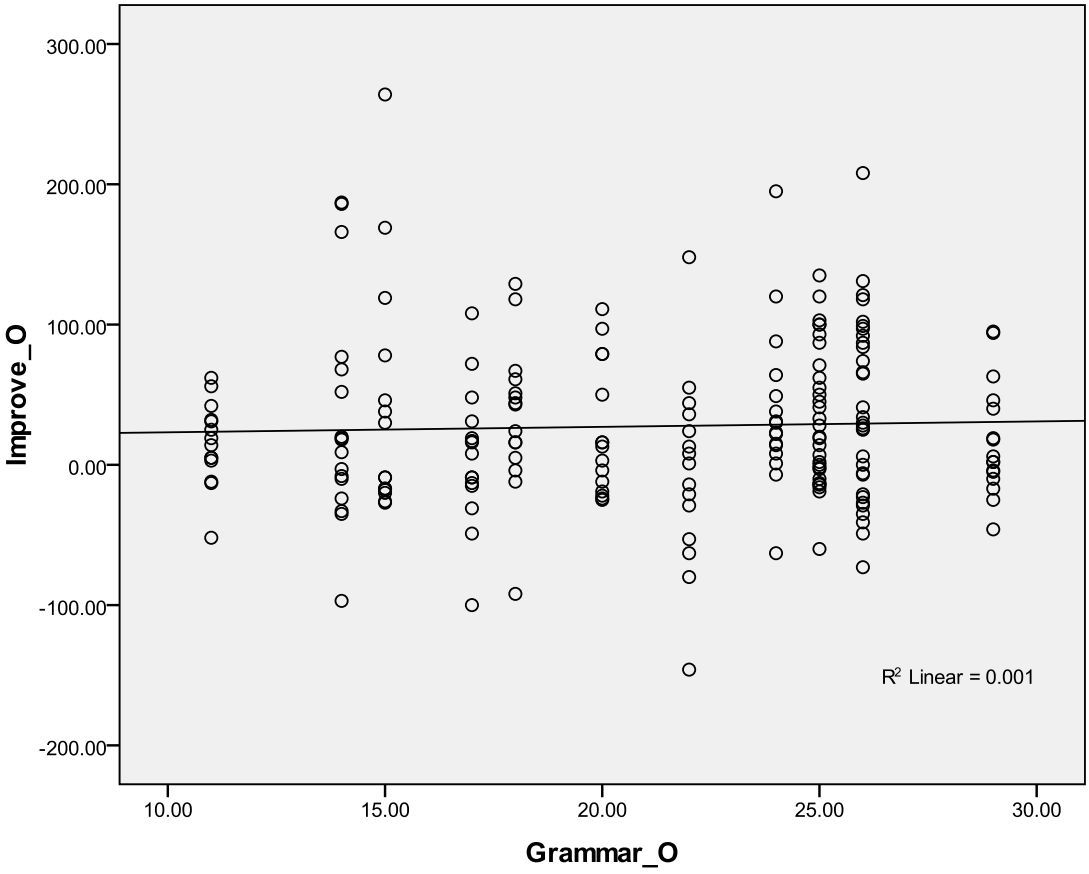


/o/ vowel

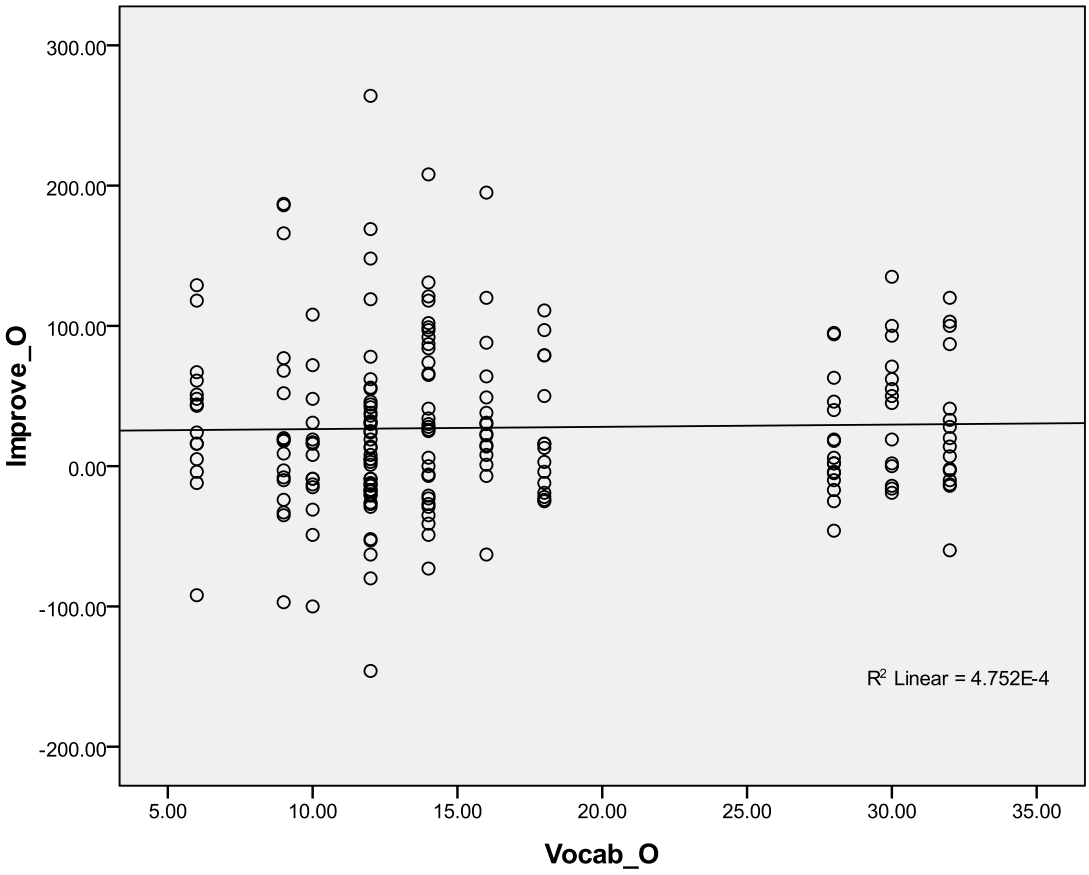
Correlation with Simon score (perception group):



Correlation with Grammar proficiency score (perception group):



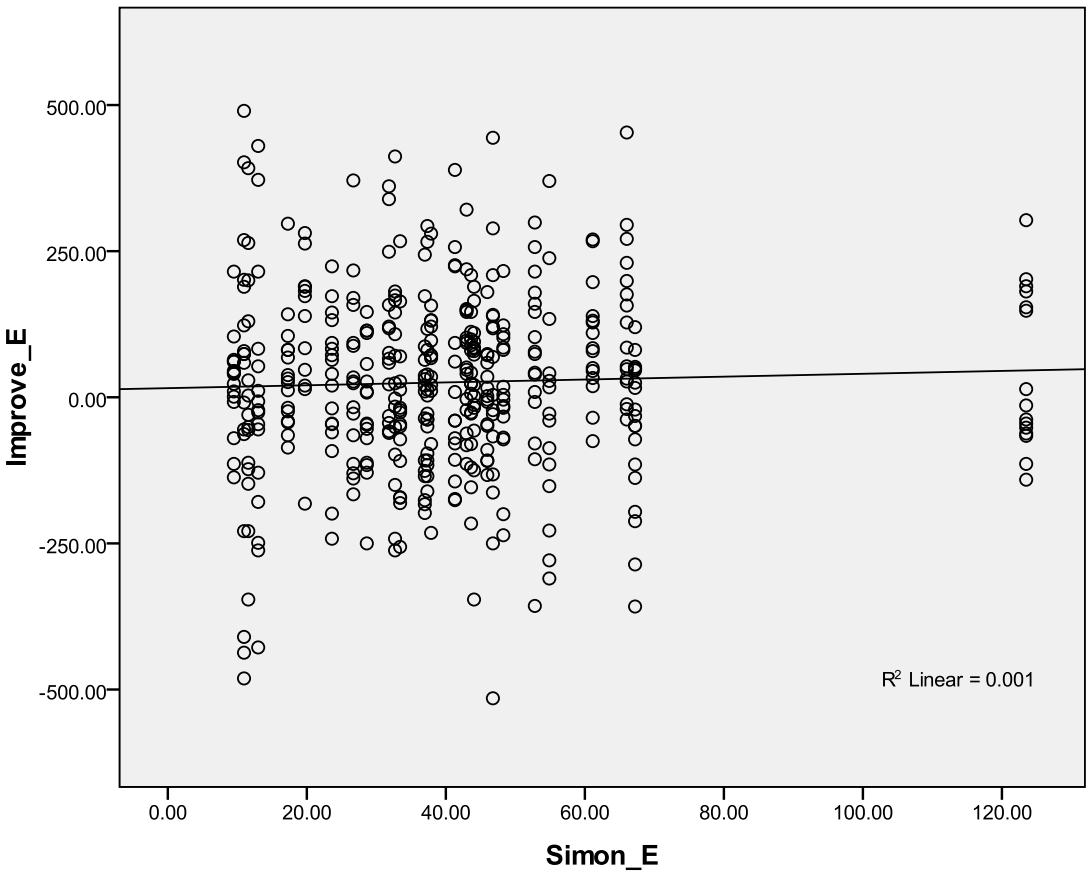
Correlation with Vocabulary proficiency score (perception group):



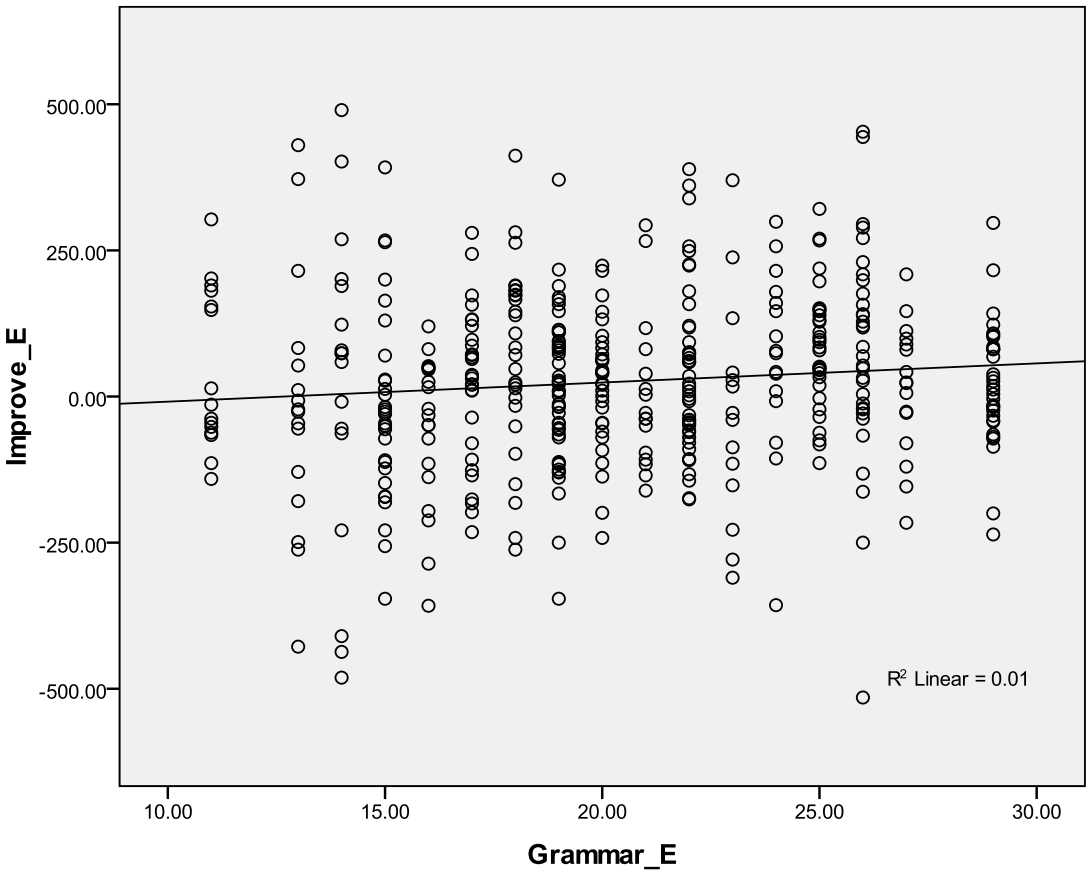
Correlations between improvement* in performance and individual difference measures for the production group.

*Improvement was measured as the difference in the change in F1 (/o/ vowel) and F2-F1 (/e/ vowel) from the pretest to the posttest.

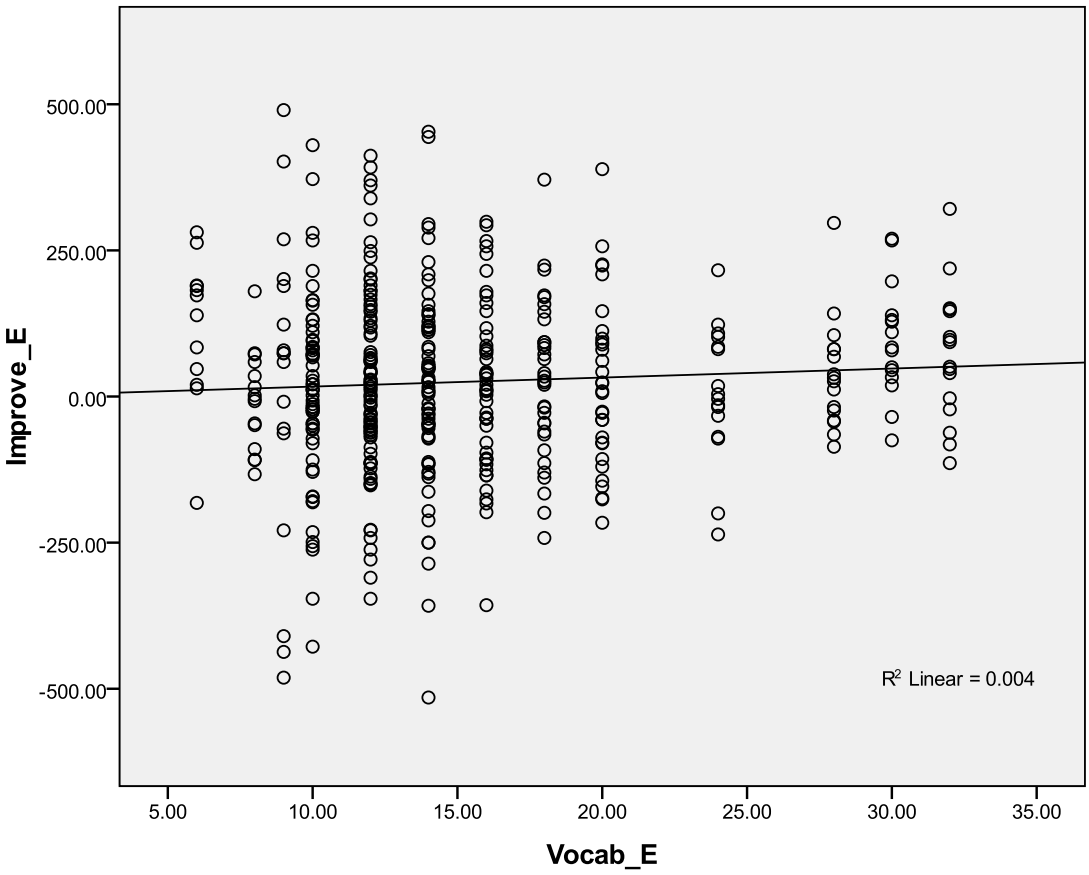
/e/ vowel - Correlation with Simon score (production group):



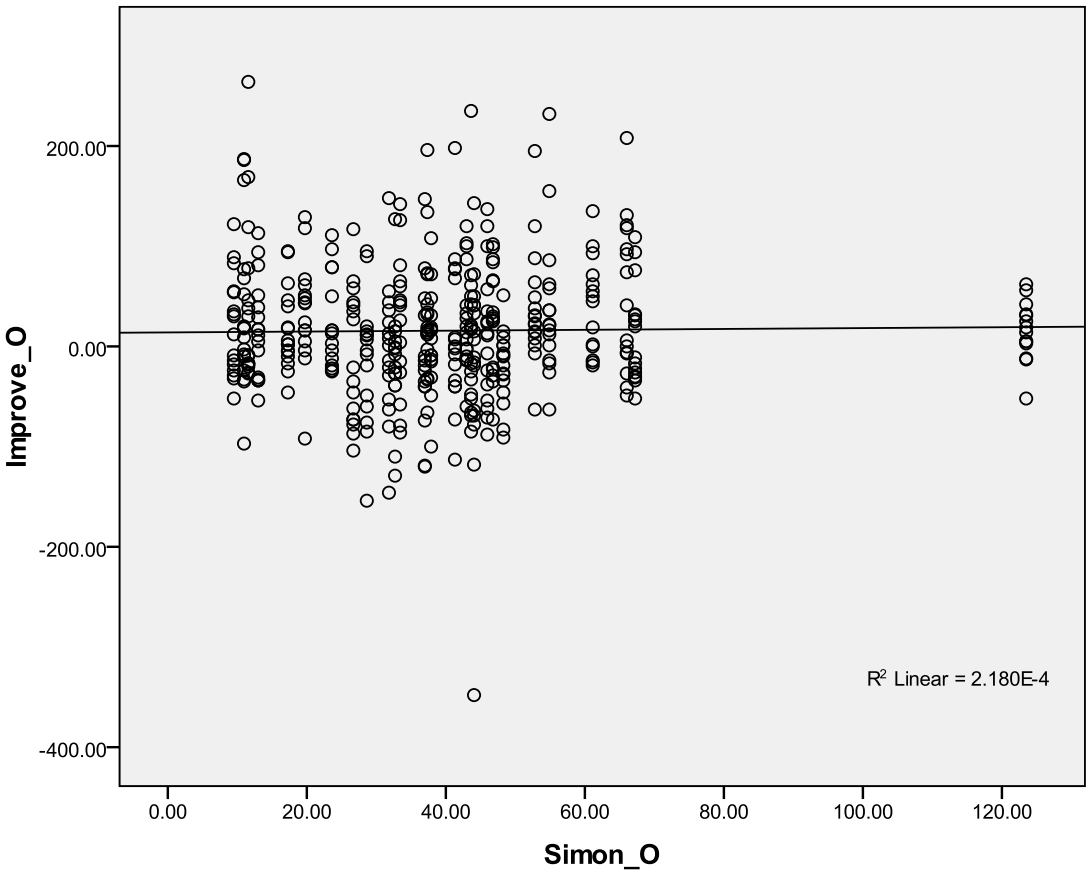
/e/ vowel - Correlation with Grammar proficiency score (production group):



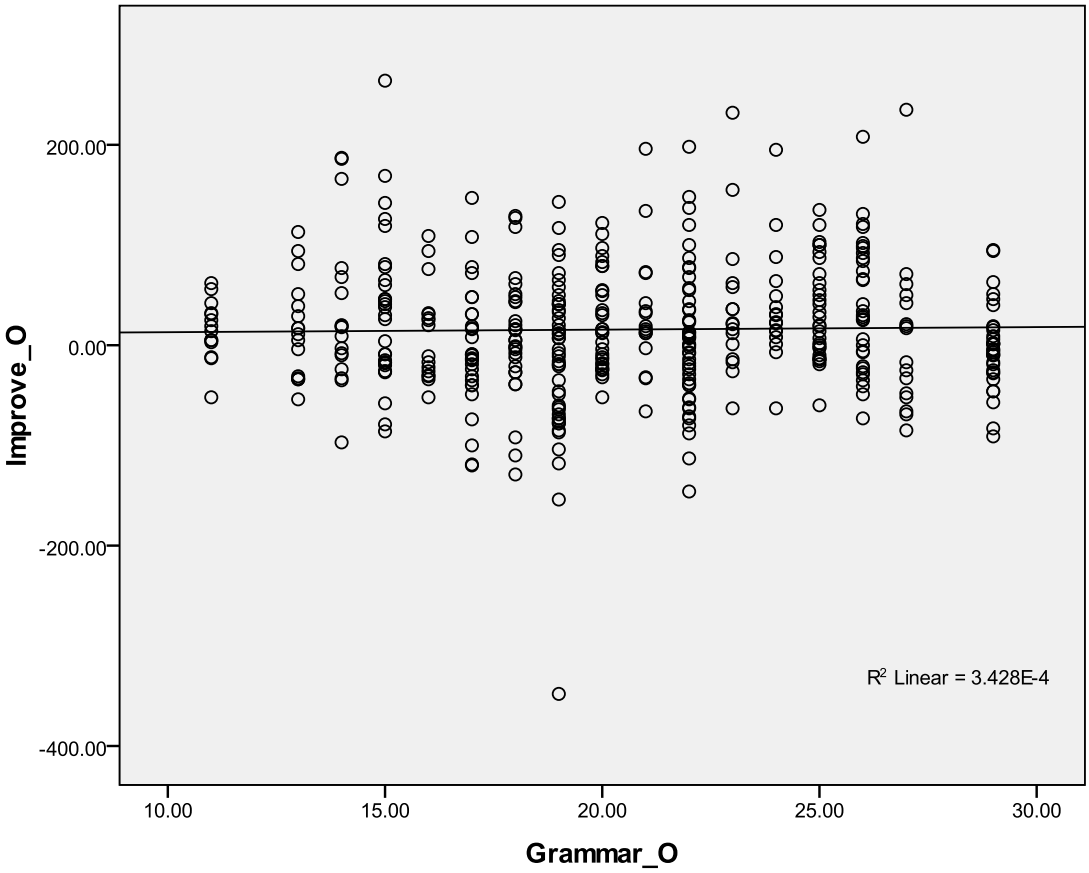
/e/ vowel - Correlation with Vocabulary proficiency score (production group):



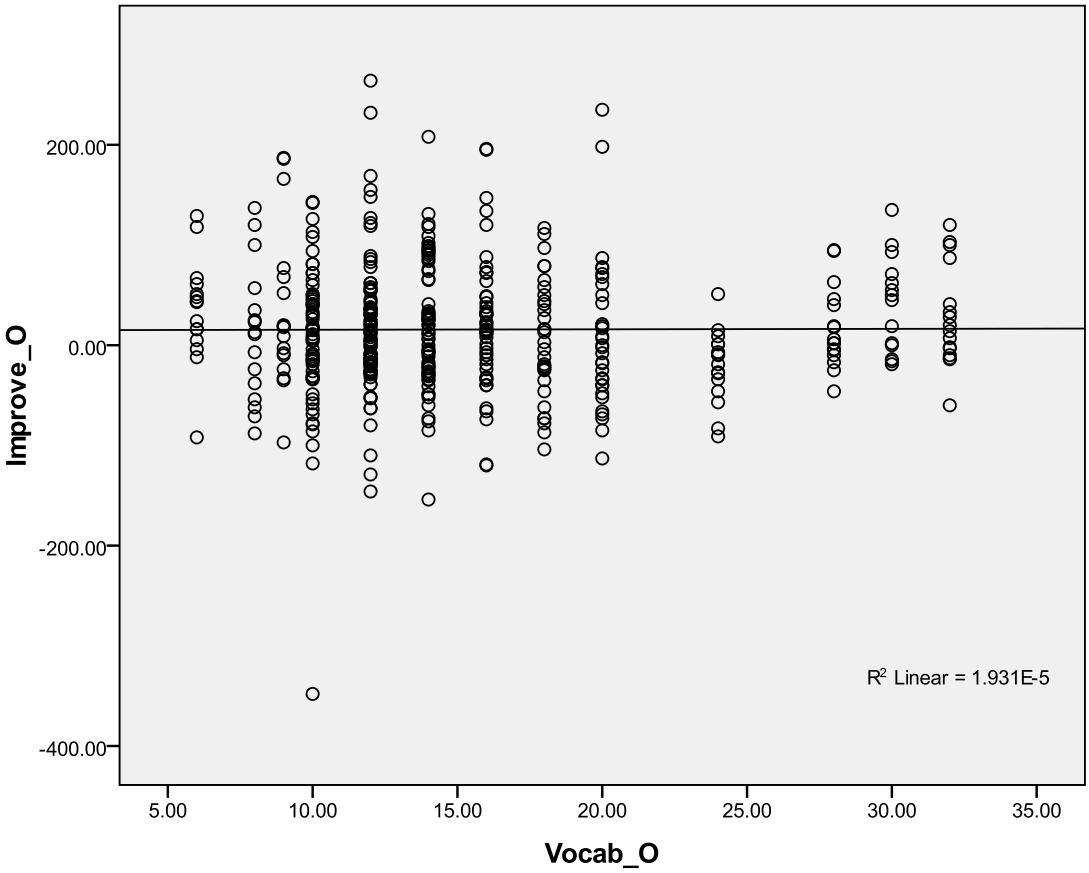
/o/ vowel - Correlation with Simon score (production group):



/o/ vowel - Correlation with Grammar proficiency score (production group):



/o/ vowel - Correlation with Vocabulary proficiency score (production group):



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CONFERENCE PRESENTATIONS

2010 *Helping Students Improve Their Spanish Pronunciation with Perception over Production*. (with P.E. Dussias). Paper presented at the Current Approaches to Spanish and Portuguese Second Language Phonology conference, University of Florida, Gainesville, FL, February.

2009 *Learning More from SLA Research: The Quantification of Diphthongs in L2 Spanish*. (with P.E. Dussias). Paper presented at the Second Language Research Forum, Michigan State University, East Lansing, MI, November.

Perception versus Production: A New Approach to Teaching Spanish Pronunciation. (with P.E. Dussias). Poster presented at the Pronunciation in Second Language Learning and Teaching conference, Iowa State University, Ames, IA, September.

Increasing Efficiency in the Teaching of Pronunciation in the L2 Spanish Classroom. Paper presented at the University of Illinois at Chicago Bilingualism Forum, University of Illinois at Chicago, Chicago, IL, April.

Increasing Students' Attention to Spanish Phonetics and Phonology in the L2 Classroom. Paper presented at the Georgetown University Round Table, Georgetown University, Washington, DC, March.

INVITED AND OTHER PRESENTATIONS

2010 *Improving Pronunciation in the Foreign Language Classroom*. Poster presented at the Pennsylvania State University Graduate Exhibition, University Park, PA, March.

2009 *Perception or Production? Improving Students' Spanish Pronunciation in the L2 Classroom*. Presentation given for the Center for Language Science, The Pennsylvania State University, University Park, PA, November.

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FELLOWSHIPS AND AWARDS

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