L2 acquisition of Spanish allophonic and Italian phonemic contrasts

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Abstract

Although Spanish and Italian voiced stops are similar in articulatory (place of articulation) and acoustic (prevoicing) terms, there are important contrasts associated with these sounds in each language that may affect second language (L2) learners' acquisition. Spanish maintains an allophonic alternation between word-initial voiced stops and intervocalic voiced approximants, which involves a variation in manner of articulation. Italian maintains a phonemic contrast between intervocalic voiced singleton and geminate stops, which involves a variation in duration. Given these differences, the present study investigates whether the sounds associated with the allophonic alternation in Spanish or those associated with the phonemic contrast in Italian are acquired more easily by L2 learners of each language who share the same L1 (American English) via production and perception tasks.

Students enrolled in first-, third-, and fourth-year courses, at the same university, in their respective L2 of Spanish or Italian were recruited for the study. 23 L2 Spanish learners, 20 L2 Italian learners, and five native speakers each of Spanish and Italian participated in the study. Production was assessed with a reading task, while perception was assessed with discrimination and identification tests.

The results of the acoustic analyses indicate that learners struggle to produce target sounds in a target-like fashion, as L2 Spanish learners produced word-initial [b d g] with significantly less prevoicing than native speakers and they infrequently produced target approximants as such. L2 Italian learners struggled to precisely implement the phonetic cues that distinguish geminate stops from their singleton counterparts (e.g.,

preceding vowel duration and consonant duration). In addition, correlation analyses revealed that L2 Spanish and L2 Italian learners' production and perception are related, although not strongly. Therefore, it is possible that learners' production difficulties have a perceptual basis, as L2 Spanish learners struggled to discriminate voiced approximants from voiced stops and L2 Italian learners struggled to identify the length difference between voiced singleton and geminate stops. This finding constitutes a valuable contribution to L2 Spanish and L2 Italian phonology, as the role of perception as a basis for learners' production difficulty of these target sounds has been understudied and not well-understood.

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Chapter 1 Introduction

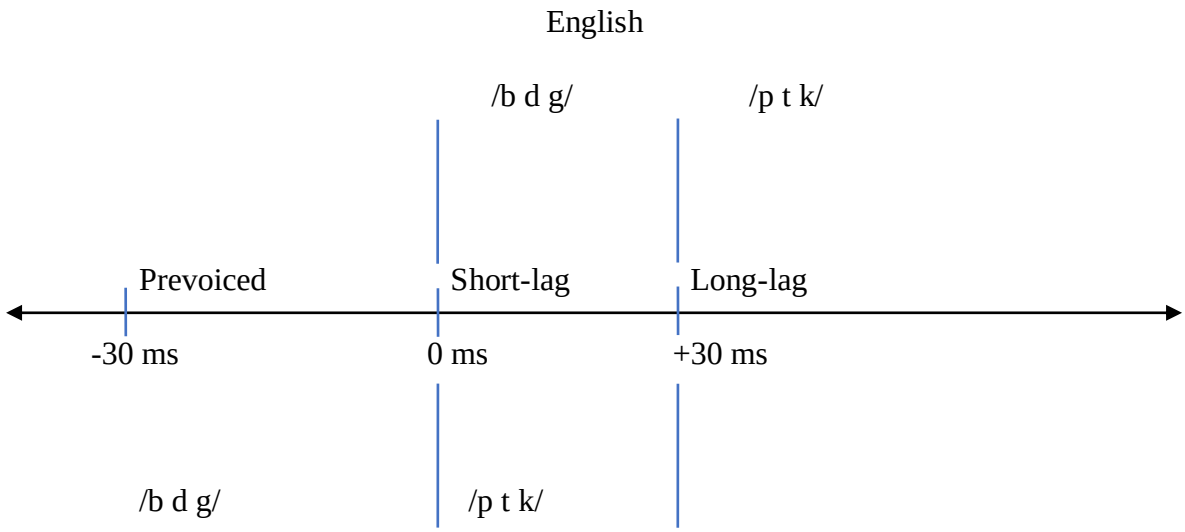
1.1 Introduction

Second language (L2) acquisition of stop consonants is particularly interesting because although stops are the most common and unmarked sounds (Ladefoged, 2001; Ladefoged & Maddieson, 1996), their production varies cross-linguistically. For example, production of English stops differs from that of Spanish and Italian stops in articulatory and acoustic terms. One of the primary phonetic differences between English, Spanish, and Italian stops concerns the place of articulation of /t/ and /d/, which is alveolar in English and dental in Spanish and Italian. L2 learners must therefore learn to make a slightly different gesture in order to accurately produce /t/ and /d/ in Spanish and Italian. The other pairs of voiceless and voiced stops share the same place of articulation in English, Spanish, and Italian, as /p/ and /b/ are bilabial and /k/ and /g/ are velar in all three languages.

Another phonetic difference between English, Spanish, and Italian stops concerns voice onset time (VOT), which is the amount of time that elapses between the release of the stop and the beginning of vocal fold vibration in the following vowel. Native English speakers have difficulty acquiring Spanish and Italian stops because there is a mismatch between the phonological categories (voiceless and voiced) and the phonetic implementation of stops in English and the two Romance languages. Voiceless stops in English are produced with long-lag VOT, while their Spanish and Italian counterparts are realized with short-lag VOT. The mismatch between the phonological category and the

phonetic implementation of voiceless stops in English, Spanish, and Italian is due to aspiration, as aspiration leads to longer VOTs in English, while its absence in Spanish and Italian leads to shorter VOTs. Voiced stops in English are realized with short-lag VOT, while voiced stops in Spanish and Italian are produced with voicing lead and are thus pre-voiced. This mismatch is due to the activity of the vocal cords, as they begin vibrating after the release of the closure in English voiced stops, but before the release of the closure in Spanish and Italian voiced stops. Figure 1 below illustrates the mismatch between the phonological categories of voiceless and voiced and the phonetic implementation of stops in English, Spanish, and Italian.

Figure 1: Stop consonant classification according to VOT duration (adapted from Zampini, Clarke, & Green, 2000)



Spanish and Italian

As a result of the aforementioned mismatches between phonological categories and the phonetic implementation of stops in English, Spanish, and Italian, native English speakers learning Spanish or Italian as an L2 are faced with several challenges.

Specifically, learners must reorganize an existing category (short-lag voicing) while eliminating another existing category (long-lag voicing) and adding a new category (voicing lead).

Although Spanish and Italian stops are similar in articulatory and acoustic terms, there are important contrasts associated with stops in each language that may affect L2 learners' acquisition. In addition to the challenges L2 Spanish learners face as a result of acoustic differences between voiceless and voiced stops in English and Spanish, they are faced with the additional challenge of acquiring a set of sounds that is generally absent from the phonemic inventory of English. Since Spanish voiced stops spirantize in certain obligatory contexts, such as intervocalic position, L2 learners must acquire the Spanish voiced stop phonemes and their corresponding approximant allophones.[1] Moreover, since Spanish voiced stops and approximants appear in different contexts, learners must learn *when* to produce each sound, so they are produced in the appropriate contexts.[2]

There are several differences between English and Spanish that may contribute to learners' difficulty in acquiring Spanish voiced approximants. Approximants in Spanish are very frequent because of the contexts in which spirantization is obligatory, whereas

[1] These allophones were traditionally labeled fricatives, but more recent work on the acoustic properties of these sounds (cf. Baković, 1994; Catford, 1977; Cole, Hualde, & Iskarous, 1999; Martínez Celdrán, 1991; Santagada & Gurlekian, 1989; Widdison, 1997) has shown that they are more accurately described as approximants. The traditional description is still occasionally employed, including in some of the studies reviewed in Chapter 2, but I refer to these sounds as approximants throughout this dissertation in all cases.

[2] Spanish voiced stops and approximants are traditionally said to occur in complementary distribution, as the stops occur in absolute utterance-initial position, after a nasal, and in the case of /d/ after /l/, while the approximants occur in all other contexts. However, regional variation in the distribution of voiced stops and approximants has been observed (cf. Amastae, 1986, 1995; Widdison, 1997; Zampini, 1994). Despite this variation, Shively (2008) and Alvord and Christiansen (2012) note that it is generally agreed upon that approximants are consistently produced in intervocalic position across dialects.

approximants in English are very infrequent because spirantization is an occasional, non-obligatory process that occurs primarily in rapid and casual speech (Brown, 1990; Gimson, 1989; Hieke, 1987). Another difference between English and Spanish is that /d/ and /ð/ contrast phonemically in English, while [d] and [ð] contrast allophonically in Spanish. Additionally, Zampini (1994) claims that first language (L1) speakers of English learning Spanish as an L2 may have difficulty acquiring Spanish /d/ and /ɾ/ because "English /d/ is pronounced as an alveolar flap in post-tonic intervocalic position, which is perceptually very similar to the Spanish tap" (p. 470). Finally, orthography may also contribute to learners' difficulty, as /ð/ is represented orthographically as "th" in English, but [ð] is represented orthographically as "d" in Spanish. Moreover, "b" and "v" represent [b] and [v], respectively, in English, but [b] or [β] in Spanish depending on the surrounding phonetic context. Due to these mismatches in grapheme-phoneme/allophone correspondences between English and Spanish, it is possible that transfer from English will occur.

In addition to the challenges L2 Italian learners face as a result of acoustic differences between voiceless and voiced stops in English and Italian, they are faced with the additional challenge of acquiring a set of sounds that is not present in English. Italian is one of few languages (e.g., Turkish, Hindi, Arabic, and Japanese) with a consonant length contrast and the only major Romance language that maintained the original geminate consonants from Latin. The opposition between short and long consonants is present in both voiceless and voiced phones and among stops, such that voiceless singleton stops contrast with voiceless geminate stops and voiced singleton stops contrast

with voiced geminate stops. Studies on the consonant length contrast in L1 Italian have found that there are three phonetic cues relevant to distinguishing singleton stops from geminate stops in production: closure duration (Cerrato & Falcone, 1998; Esposito & Di Benedetto, 1999; Pickett, Blumstein, & Burton, 1999; Rosenzweig, 1965), preceding vowel duration (Esposito & Di Benedetto, 1999; Fava & Magno Caldognetto, 1976; Josselyn, 1900; Parmenter & Carman, 1932; Pickett et al., 1999), and the ratio between consonant closure duration and preceding vowel duration (i.e., C/V ratio) (Pickett et al., 1999).

Since English lacks geminates, native English-speaking L2 Italian learners must acquire new sounds that have no corresponding counterparts in their L1. Acquisition of Italian geminates by these L2 learners could be challenging because they must precisely implement the three aforementioned phonetic cues to successfully differentiate singleton and geminate stops. Specifically, learners must produce geminate stops with a greater closure duration than singleton stops, as experimental studies (Cerrato & Falcone, 1998; Chang, 2000; Esposito & Di Benedetto, 1999; Pickett et al., 1999) and traditional descriptions of the consonant length contrast in Italian (Agard & Di Pietro, 1965; Clivio & Danesi, 2000; Josselyn, 1900; Parmenter & Carman, 1932; Vogel, 1982) have reported that the duration of geminate consonants is approximately twice as long as their singleton counterparts. Learners must also alter their pronunciation of the preceding vowel according to the following consonant, as the duration of a vowel preceding a geminate is shorter than that preceding a singleton (Chang, 2000; Esposito & Di Benedetto, 1999; Pickett et al., 1999). Finally, learners' C/V ratio for geminates must be approximately

double the C/V ratio for singletons (Pickett et al., 1999). Successful acquisition of the singleton/geminate stop contrast therefore depends on accurate production of both the consonant and the preceding vowel.

Although Spanish and Italian stops are similar acoustically in terms of VOT, the different contrasts associated with voiced stops in each language make acquisition particularly interesting, as they may affect acquisition differently. The contrast between Spanish voiced stops and approximants is allophonic, while the contrast between Italian voiced singleton and geminate stops is phonemic. The distinction between singletons and geminates is especially important in minimal pairs such as *cade* ('s/he/it falls') vs. *cadde* ('s/he/it fell') because mispronouncing one of these phones changes a word's meaning and may impede comprehensibility. Conversely, since the difference between [d] and [ð] in Spanish is allophonic, producing a stop or an approximant in an incorrect context will not change a word's meaning. Given that incorrect production of a geminate changes a word's meaning in certain contexts, while incorrect production of a Spanish approximant does not, it may appear that acquisition of the Italian singleton/geminate stop contrast is more important than acquisition of the Spanish voiced stop/approximant alternation. However, it may be argued that acquisition of both contrasts is equally important because non-target-like production of these sounds leads to foreign-accented speech, as reported in L2 studies on both languages (Spanish: Alvord & Christiansen, 2012; Elliott, 1997; González-Bueno & Quintana-Lara, 2011; Lord, 2005, 2010; Shively, 2008; Italian: Kabak, Reckziegel, & Braun, 2011). Citing Flege's (1988) findings, Munro (2008) reports possible consequences of foreign-accented speech for L2 learners, including

"accent detection, diminished acceptability, diminished intelligibility, and negative evaluation" (p. 195).[3] In addition, LeVelle and Levis (2014) further underscore the importance of social factors in L2 pronunciation, as foreign-accented speech may affect learners' participation in established social groups and the way in which they express and understand their identity in the L2, and may also lead to stigma and shame. Foreign-accented speech may therefore serve as a barrier to entering social networks within the target language (TL) community.

While separate studies have been carried out on L2 acquisition of Spanish voiced stops and approximants (Alvord & Christiansen, 2012; Castino, 1996; Díaz-Campos, 2004, 2006; Elliott, 1997; Face & Menke, 2009; González-Bueno, 1994, 1995; González-Bueno & Quintana-Lara, 2011; Kissling, 2013; Lord, 2005, 2010; Rogers & Alvord, 2014; Shively, 2008; Stevens, 2000; Zampini, 1994, 1998) and of Italian stops (Celata & Costamagna, 2011; De Clercq, Simon, & Crocco, 2014; Grassegger, 1991; Harris, 2010; Kabak et al., 2011; Rochet & Rochet, 1995), the potential effect of allophonic and phonemic contrasts on L2 acquisition has not yet been investigated. The present study aims to bridge this gap in the literature by examining acquisition of Spanish and Italian voiced stops by separate groups of university-level L2 learners whose L1 is English. This study attempts to answer several questions that had not been addressed by previous studies regarding learners' acquisition of the target sounds.

[3] Cf. Munro (2008) for a discussion of each of these consequences.

1.2 Research Questions

The main research question that motivated the present study is: Are allophonic or phonemic contrasts acquired more easily by L2 learners of two different Romance languages (Spanish and Italian) from the same L1 background (American English)? In order to determine whether L2 learners acquire allophonic or phonemic contrasts more easily, this study examines learners' productive and perceptive abilities and addresses the following research questions:

1. Are L2 learners more accurate in producing or perceiving the sounds associated with allophonic and phonemic contrasts in their respective L2? In other words, are L2 Spanish learners more accurate in producing or perceiving voiced stops and approximants? Are L2 Italian learners more accurate in producing or perceiving Italian voiced singleton and geminate stops?
2. How do learners at different instruction levels produce and perceive the sounds associated with allophonic and phonemic contrasts in their respective L2? Is there development between levels?
3. Are learners' productive and perceptive abilities related?
4. Do L2 learners (L1 American English) better perceive the allophonic alternation between Spanish voiced stops and approximants or the phonemic contrast between Italian voiced singleton and geminate stops?

1.3 Hypotheses

The present study empirically tests the following hypotheses formulated based on the aforementioned research questions. First, it is hypothesized that L2 learners will be more accurate in perceiving rather than producing the sounds associated with allophonic and phonemic contrasts in their respective L2. Specifically, it is hypothesized that L2 Spanish learners will be more accurate in perceiving rather than producing voiced stops and approximants because previous L2 Spanish acquisition studies on production have documented learners' difficulty producing voiced stops with prevoicing (González-Bueno, 1994; Zampini, 1998) and approximants in their required contexts (Díaz-Campos, 2004, 2006; Elliott, 1997; González-Bueno, 1995; Kissling, 2013a; Lord, 2010; Shively, 2008; Zampini, 1994). Based on the findings of previous L2 Italian research, discussed in Chapter 3, it is hypothesized that L2 Italian learners will be more accurate in perceiving rather than producing voiced singleton and geminate stops. These hypotheses are also supported by Lord's (2002) finding from a study on L2 acquisition of Spanish stress that receptive skills are acquired before productive skills, which in turn supports Flege's (1995) Speech Learning Model (SLM) that is further discussed in this chapter.

Second, it is hypothesized that L2 learners' production and perception of the sounds associated with the target contrast in their respective L2 will show development across instruction levels. It is therefore predicted that L2 learners' production and perception accuracy will increase from the first- to the third- to the fourth-year of language study. This hypothesis is supported by the findings from previous cross-sectional studies on L2 acquisition of Spanish and Italian stop consonants, reviewed in

Chapters 2 and 3 (Face & Menke, 2009; González-Bueno & Quintana-Lara, 2011; Harris, 2010; Kabak et al., 2011; Kissling, 2013a; Shively, 2008).

Third, it is hypothesized that L2 learners' productive and perceptive abilities are related. It is therefore predicted that if learners struggle to perceive differences between target sounds in their respective L2, they will likewise struggle to produce them. Alternatively, if learners have difficulty producing the target sounds in their respective L2, they will also have difficulty perceiving differences between target sounds in their respective L2. Findings from previous studies support this hypothesis that L2 production and perception are related (González-Bueno & Quintana-Lara, 2011; Kissling, 2013a).

Finally, it is predicted that L2 learners (L1 American English) will better perceive the Italian phonemic contrast than the Spanish allophonic alternation because allophonic differences are subtler than phonemic differences. Generally, it may be hypothesized that L2 learners would better perceive a phonemic contrast because it affects lexical meaning whereas an allophonic contrast does not. However, since the stimuli used in the present study were nonce words, an alternative justification is needed. It is possible that learners would better perceive the Italian phonemic contrast because it involves an alteration in the production of both the consonant and preceding vowel, while the Spanish allophonic alternation only concerns a variation in the manner of articulation of the consonant.

1.4 L2 Phonological Acquisition Theories

Focusing on voiced stops, this study empirically investigates some of the key claims of L2 phonological acquisition theories, such as whether similarity between L1 and L2 sounds facilitates or impedes second language acquisition (SLA) and whether accurate perception of L2 sounds is a necessary precursor to accurate production. The issue of similarity has long been examined in L2 phonology research, dating from some of the earliest theories such as the Contrastive Analysis Hypothesis (CAH) to more recent ones such as Major and Kim's (1996) Similarity Differential Rate Hypothesis (SDRH). Lado (1957) first theorized about the role of similarity in SLA, claiming that L2 structures that are similar to structures in a learner's L1 will be acquired more easily than dissimilar structures. The CAH, employed in SLA research in the 1960s and early 1970s, was based on Lado's claim and predicted that transfer plays a fundamental role in the acquisition process. As Major (2008) points out, initially, the CAH made the strong claim that "transfer explains all errors and on this basis, it is possible to predict all errors" (p. 64). In a revision of the CAH, Oller and Ziahosseiny's (1970) *moderate version* explicitly included the notion of similarity, claiming, in opposition to Lado (1957), that L2 structures similar to L1 structures are more difficult to acquire than dissimilar ones. Incorporating the notion of markedness, Eckman's (1977) Markedness Differential Hypothesis (MDH) claimed that L2 structures that are both different from and more marked than L1 structures will be more difficult to acquire than L2 structures that are different from L1 structures but are not more marked.

While the CAH and MDH examined transfer, similarity, L1/L2 differences, and markedness, Major's (1986a) Ontogeny Model (OM) and (2001) Ontogeny Phylogeny Model (OPM) were the first L2 phonological acquisition theories to focus on the interaction of several of these factors in the acquisition process. Specifically, the OM and OPM describe the interaction between transfer and developmental processes (language universals), claiming that transfer processes rather than developmental processes more strongly influence acquisition at the beginning stages, developmental processes then increase, and finally decrease along with transfer processes at later stages (Major, 2001). Similar to the *moderate version* of the CAH, the OM and OPM claim that L2 phenomena with similar L1 counterparts are more difficult to acquire than dissimilar phenomena and lead to transfer because minimal differences are less likely to be noticed. While the *moderate version* of the CAH, MDH, OM, and OPM predicted L2 learning difficulty, Major and Kim's (1996) SDRH focused on rate of acquisition, proposing that dissimilar phenomena are acquired faster than similar ones. In summary, although Lado (1957) posited that similar L2 structures are acquired more easily than dissimilar structures and Eckman's (1977) MDH proposed that unmarked L2 structures, whether similar to or different from L1 structures, will be acquired more easily than marked L2 structures, all other subsequent theories (e.g., the *moderate version* of the CAH, OM, SDRH, and OPM) resoundingly claimed that similarity between L1 and L2 structures slows down SLA, as L2 structures with similar L1 counterparts are more difficult to acquire.

The issue of similarity between L1 and L2 sounds is also incorporated into Flege's (1995) Speech Learning Model (SLM), which was designed to address

production and perception of L2 speech by L2 learners.[4] Focusing on learners' productive and perceptive abilities, the present study tests some of the claims of Flege's SLM, according to which accurate perception of L2 sounds is a necessary precursor to accurate production of L2 sounds. The seven hypotheses of the SLM focus specifically on perception because one of the "basic tenets of the model is that many, but not all, L2 production errors have a perceptual basis" (Flege, 1995, p. 238). The third, fifth, and seventh hypotheses are most relevant to the current study. The third hypothesis claims that greater phonetic dissimilarity between L1 and L2 sounds facilitates accurate perception because it is more likely that differences between dissimilar L1 and L2 sounds will be noticed. According to this hypothesis, it may be predicted that differences in VOT between Spanish and English word-initial voiced stops will facilitate accurate perception of target Spanish voiced stops while the existence of similar, although infrequent voiced approximants in English and the subtle difference between Spanish voiced approximants and English voiced stops will not facilitate accurate perception of target Spanish voiced approximants. In addition, based on this hypothesis, it may be predicted that the greater phonetic dissimilarity between Italian voiced geminate stops and English voiced stops than between Italian voiced singleton stops and English voiced stops will facilitate accurate perception of target Italian voiced geminate stops.

The fifth hypothesis, based on the notion of equivalence classification (Flege, 1987b), proposes that a category may not be established for an L2 sound if it is perceived as equivalent to an L1 sound. Equating the L2 sound to the L1 sound blocks the

[4] While other L2 phonological acquisition theories focus exclusively on perception (cf. Best & Tyler, 2007; Escudero, 2005), the present study focuses on the SLM because it examines the relationship between L2 speech production and perception.

establishment of a separate phonetic category for the L2 sound, which is why Flege proposes that similar L2 sounds may be more difficult to acquire than L2 sounds that do not have corresponding counterparts in the L1. According to this hypothesis, it may be predicted that L2 Spanish learners will fail to establish separate phonetic categories for Spanish voiced stops and approximants if they are perceived as equivalent to English voiced stops. Similarly, it may also be predicted that L2 Italian learners will not establish separate phonetic categories for Italian voiced singleton and geminate stops if they are perceived as equivalent to English voiced stops. Finally, the seventh hypothesis claims that an L2 sound will be produced according to how it is perceived (i.e., how it is represented in the phonetic category). Accordingly, it may be predicted that Spanish voiced approximants and Italian voiced geminate stops will not be produced in a target-like fashion if they are not perceived as approximants and geminates, respectively.

1.5 L2 Production/Perception Interface Research

There is a long line of research both predating and following Flege's (1995) SLM that has empirically investigated the relationship between L2 speech perception and production. Some studies have found that perception precedes production, while others have found that production precedes perception. Llisterri (1995) provides a review of previous literature vis-à-vis the relationship between L2 productive and perceptive abilities.

Some of the earliest research addressing this topic was conducted by Polivanov (1931) and Trubetzkoy (1939), who concluded that perception precedes production.

Polivanov and Trubetzkoy similarly claimed that L2 sounds are perceived according to the L1 phonological system, which acts as a filter; and thus, difficulties in the production of L2 sounds are attributed to influence of the L1 phonology. Borden, Gerber, and Milsark's (1983) study on L2 acquisition of English /l/ and /r/ by L1 Korean speakers provided empirical support for the claim that perception precedes production. Barry (1989) further supported this claim, finding that native German speakers learning English as an L2 first acquired the ability to perceive phonological contrasts between English vowels followed by more accurate production. Contrary to Polivanov and Trubetzkoy's claim, Sheldon and Strange (1982) did not find that perception precedes production, finding instead that Japanese speakers of English living in the United States more accurately produced than perceived the English contrast between /r/ and /l/. In addition, Borrell (1990) concluded that production and perception are not necessarily interdependent, as not all L2 sounds that are correctly perceived will in turn be accurately produced.

In addition to these studies on L2 acquisition of English, L2 acquisition studies on Spanish have similarly examined the relationship between learners' productive and perceptive abilities. Flege's (1995) SLM is widely cited in L2 phonological acquisition studies on Spanish (Alvord & Christiansen, 2012; Cobb & Simonet, 2015; Face, 2006; González López & Counselman, 2013; González López, 2012; Henriksen, Geeslin, & Willis, 2010; Hurtado & Estrada, 2010; Kissling, 2013a; Olsen, 2012; Reeder, 1998; Rose, 2012; Saalfeld, 2012; Shively, 2008; Stevens, 2000; Zampini, 1998); however, few such studies have empirically tested its claims (e.g., González López & Counselman,

2013; Kissling, 2013a; Reeder, 1998; Zampini, 1998). The results of González López and Counselman (2013) support Flege's hypothesis that L2 perception precedes L2 production because the learners in their study would not have been able to successfully form L2 categories for Spanish /p/ and /t/ without having first perceived the differences between these sounds in English and Spanish. Reeder's (1998) findings also support Flege's SLM since learners' production of Spanish voiceless stops, which initially showed L1 transfer from English in the form of long-lag VOT values, began approximating more target-like norms through reduced VOT values; thus, providing evidence that learners were in the process of establishing new phonetic categories for Spanish /p t k/. Reeder's findings also support the SLM's claim that dissimilar sounds are easier to acquire than similar sounds because the learners in his study acquired the trill, which does not have an English counterpart, more completely and consistently than voiceless stops. Kissling (2013a) and Zampini (1998) tested the SLM's claim that learners' ability to produce L2 sounds is related to their ability to perceive them. As is discussed in greater detail in Chapter 2, Kissling's results for the voiced approximants support this hypothesis, while Zampini's results for /p/ and /b/ do not. In light of these conflicting findings, the present study further investigates some of the SLM's claims as they pertain to L2 learners' acquisition of the Spanish voiced stop/approximant contrast and the Italian voiced singleton/geminate stop contrast.

While Flege's SLM allows us to make predictions about L2 learners' production and perception of target sounds based on differences between each language and English and the studies reviewed above provide insight into the relationship between L2

production and perception, it is also helpful to review previous studies on acquisition of allophonic and phonemic contrasts. Although L2 acquisition of allophonic and phonemic contrasts has not yet been investigated, the results of studies on L1 acquisition of allophonic and phonemic contrasts may shed light on L2 acquisition of these contrasts because in both situations learners are acquiring new target contrasts. In order to further contextualize the present study within the current body of work on acquisition of allophonic and phonemic contrasts, L1 acquisition studies on allophonic and phonemic contrasts are reviewed in the following subsection.

1.6 Review of L1 Acquisition Studies on Allophonic and Phonemic Contrasts

Macken and Barton (1979) investigated monolingual children's acquisition of the phonemic contrast between Spanish voiceless and voiced stop minimal pairs and the allophonic contrast between Spanish voiced stops and approximants. Macken and Barton (1979) found that:

> On the basis of the strong VOT criteria, only two of the seven children could be said to have acquired the phonemic contrast between Spanish voiceless and voiced stop minimal pairs and at only one place of articulation (bilabial). In contrast, on the basis of the spirantization criterion, we can conclude that four children had acquired the allophonic contrast between Spanish voiced stops and approximants at all three places of articulation, the fifth child at two places (bilabial and dental), and the sixth and seventh children at one place (bilabial and velar, respectively). (p. 60)

The results indicate that for these L1 Spanish speakers, the allophonic contrast is acquired more easily and much more completely than the phonemic contrast.

More recently, Seidl, Cristià, Bernard, and Onishi (2009) investigated L1 acquisition of allophonic and phonemic contrasts in infants learning French and English. Both French and English contain oral and nasal vowels, but the contrast between oral and nasal vowels in French is phonemic, whereas in English it is allophonic. Seidl et al.'s objective was to examine how learners process these sounds that form allophonic and phonemic contrasts in their respective L1. L1 learners of French processed these sounds better than L1 learners of English. Specifically, Seidl et al. (2009) found that "French-learning 11-month-old infants generalized novel phonotactic patterns to new oral and nasal vowels, whereas 11-month-old English learners showed no evidence of either learning or generalizing the same patterns" (p. 197). The results of this study therefore suggest that the phonemic contrast present in oral and nasal vowels in French is more easily acquired than the allophonic contrast present in oral and nasal vowels in English.

The results of studies on native speakers' processing of allophonic and phonemic contrasts may provide additional insight. Peperkamp, Pettinato, and Dupoux (2003) investigated whether adult monolingual French native speakers exhibit differences in the perception of allophonic versus phonemic contrasts in French. Peperkamp et al. found that listeners perceived phonemic contrasts presented in isolated syllables and in a phonological context more accurately than allophonic contrasts presented in isolation and in context. However, their perception accuracy of allophonic and phonemic contrasts in isolation was not significantly different. Conversely, when the contrasts were embedded

in a phonological context, the French monolinguals' perception accuracy of allophonic and phonemic contrasts was significantly different, as the phonemic contrast was perceived significantly more accurately than the allophonic one. Since the phonemic contrast was perceived more accurately than the allophonic contrast in both contexts and the difference in accuracy when the contrasts were embedded in a phonological context was significant, the results of this study suggest that native speakers better process phonemic contrasts.

Similarly, citing research on native speakers' processing of allophonic and phonemic contrasts, Seidl et al. (2009) claim that "adults generally process phonemic contrasts more efficiently than allophonic ones. Adults generally exhibit poorer and slower discrimination between allophones of the same phoneme than between two different phonemes (Boomershine, Hall, Hume, & Johnson, 2008; Whalen, Best, & Irwin, 1997)" (p. 192). Finally, Pegg and Werker (1997) also found that adults' perception of an allophonic contrast was worse than a phonemic contrast in English. In summary, the results of studies on native speakers' perception of allophonic and phonemic contrasts and on L1 acquisition of these contrasts indicate that phonemic contrasts are better perceived. The present study examines how adult L2 learners produce and perceive these contrasts.

The present study attempts to bridge gaps in the literature by investigating L2 Spanish and Italian learners' productive and perceptive abilities of sounds associated with either an allophonic or phonemic contrast in their respective L2. Production is assessed with a reading task, while perception is assessed with discrimination and identification

tests. Learners' acquisition is measured against the production and perception of the same sounds by a control group of native speakers of Spanish and Italian. University-level L2 learners were recruited from three different instruction levels in order to address the issue of how acquisition of allophonic and phonemic contrasts develops over time. The remainder of this dissertation is organized as follows: Chapter 2 reviews studies on L2 acquisition of Spanish voiced stops and approximants by native English speakers. Chapter 3 reviews studies on L2 acquisition of Italian stops. Chapter 4 explains the methodology used in the present study. Chapter 5 presents the results and Chapter 6 discusses the findings of this study in light of the research questions and hypotheses presented earlier as well as in light of Flege's (1995) SLM. Chapter 6 also summarizes the conclusions and contributions of this study. Finally, limitations of the present study and directions for future research regarding L2 acquisition of the allophonic alternation between Spanish word-initial voiced stops [b d g] and intervocalic voiced approximants [β ð γ] and of the phonemic contrast between Italian intervocalic voiced singleton stops /b d g/ and voiced geminate stops /b: d: g:/ are addressed at the end of Chapter 6.

Chapter 2 Review of Studies on L2 Acquisition of Spanish Voiced Stops and Approximants

2.1 Introduction

Studies on L2 acquisition of Spanish voiced stops and approximants by native English speakers have largely examined the effect of the following non-linguistic factors: explicit pronunciation instruction, context of learning, and speech style; and to a much lesser degree the effect of other non-linguistic variables, such as gender, learner concern with pronunciation, and cultural integration and sensitivity, among others. The effect of explicit pronunciation instruction on L2 acquisition of Spanish voiced stops and approximants has been well documented, as it is the extralinguistic factor that has received the most attention (Castino, 1996; Elliott, 1997; González-Bueno, 1994, 1997a; Kissling, 2013a, 2013b; Lord, 2005, 2010). Many of these studies investigated only acquisition of voiced stops (González-Bueno, 1994, 1997a) or of voiced approximants (Castino, 1996; Kissling, 2013a, 2013b; Lord, 2005; Rogers & Alvord, 2014; Stevens, 2000), while only Elliott (1997) and Lord (2010) investigated acquisition of both voiced stops and approximants.[5] Empirical studies that have examined the effect of the aforementioned non-linguistic variables and of linguistic variables such as syllable stress and word position on L2 acquisition of Spanish voiced stops and approximants by native English speakers are discussed in each of the following subsections.

[5] González-Bueno (1997a) is based on González-Bueno's (1994) doctoral dissertation and Kissling (2013b) is based on Kissling's (2013a) doctoral dissertation and thus are not discussed separately, as the experiments and results reported in their respective articles are the same as those reported in their dissertations.

2.2 Explicit Instruction

González-Bueno (1994) was the first study to investigate the effect of formal instruction on the pronunciation of Spanish stops by native English speakers learning Spanish as a second language.[6] Sixty L2 Spanish learners enrolled in a fourth-semester intermediate conversation course participated in the study. Learners were evenly divided into an experimental group that received formal pronunciation instruction and a control group that did not receive such instruction.[7] Learners in both groups were administered a modified oral proficiency interview (OPI) in Spanish at the beginning (pretest) and end of the semester (posttest).[8] González-Bueno measured voice onset time (VOT) of voiceless and voiced stops in stressed syllable-initial position followed by a non-front vowel.

The experimental and control groups produced very similar mean VOTs for /b/ on both the pretest and posttest. The experimental group's mean VOT for /b/ was 19.55 ms on the pretest and 17.15 ms on the posttest, while the control group's mean VOT was 19.69 ms on the pretest and 18.56 ms on the posttest. Although the experimental group reduced its mean VOT for /b/ more than the control group, this difference in improvement was not significant. The experimental group reduced its mean VOT for /d/

[6] González-Bueno investigated the effect of formal pronunciation instruction on L2 learners' acquisition of both voiceless and voiced stops; however, given the focus of the present study, only the results for voiced stops are discussed.

[7] Instruction consisted of practical exercises and drills for five to ten minutes at the beginning of each class. The instructor spent approximately three weeks on each voiceless/voiced stop pair: /p/ and /b/, /t/ and /d/, and /k/ and /g/. Learners were introduced to articulatory and acoustic differences between Spanish and English voiceless stops and between Spanish voiceless and voiced stops. Students also completed perceptual discrimination tasks between Spanish voiceless and voiced stops and pronunciation drills. They also practiced their pronunciation in communicative, meaning-focused activities.

[8] The pretest OPIs were administered to learners before the experimental group received formal pronunciation instruction, while the posttest OPIs were administered after the experimental group received such instruction.

from 26.03 ms to 20.17 ms, while the control group increased its mean VOT from 31.48 ms on the pretest to 32.31 ms on the posttest. Despite the observed improvement in the experimental group, the difference between its pretest and posttest VOT values was not significant. Finally, both groups of learners reduced their mean VOTs for /g/, but the experimental group showed a greater reduction from 43.40 ms on the pretest to 21.23 ms on the posttest compared to the control group which reduced its mean VOT from 38.80 ms to 34.53 ms. This difference in improvement was significant, as the experimental group decreased its VOT for /g/ significantly more than the control group as a result of formal pronunciation instruction.

There was a hierarchy in improvement on the voiced stops, as learners in the experimental group improved their pronunciation of /g/ the most, followed by /d/, and /b/. González-Bueno proposes a reverse acquisition order hypothesis to explain the greatest improvement of /g/, arguing that since velar stops are acquired last in English, they are least resistant to modification and hence more unstable when learning Spanish, resulting in the most amount of improvement among the Spanish voiced stops. Furthermore, González-Bueno (1994) claims that:

> If the late acquisition of /g/ in L1 has an effect on the earlier improvement of this sound in L2, as suggested by the "reverse acquisition order" hypothesis, this could be interpreted as a transfer process, since the way in which L1 /g/ was acquired influences the way /g/ is learned in L2. (pp. 169-170)

Therefore, the significant improvement observed in the experimental group for /g/ is an effect of the formal pronunciation instruction they received as well as of transfer.

In summary, the learners in the experimental group reduced their mean VOTs for all stop consonants; however, despite this improvement their VOT values on the posttest were still outside of the Spanish short-lag range for voiceless stops and the pre-voiced range for voiced stops. The learners in the control group did not consistently shorten their VOT values, which actually increased from the pretest to the posttest on some sounds (e.g., /t d k/). When learners in the control group did reduce their mean VOTs, the decreases were smaller than those made by the learners in the experimental group. Finally, the results of this study indicate that formal pronunciation instruction does have a positive effect on learners' pronunciation, but the effects are not equal across all L2 sounds.

Similar to González-Bueno (1994), Castino (1996) investigated the effect of explicit instruction on L2 learners' acquisition of Spanish sounds; however, the target L2 phones and type of instruction were different. In light of impressionistic claims (Cadierno, 1993; Catford & Pisoni, 1970; Mason, 1990; VanPatten & Cadierno, 1993) that explicit pronunciation instruction in the form of a phonetics course is necessary for L2 learners to improve their pronunciation, Castino (1996) empirically investigated the effect of a Spanish phonetics course on learners' pronunciation of the voiced approximant [β ð γ] allophones in order to quantify the observed improvement. Forty native English-speaking L2 learners in their third- or fourth-year of university-level Spanish who were enrolled in Spanish phonetics participated in the study.[9]

[9] Course instruction consisted of explanation of and practice with key concepts of Spanish phonetics, such as point of articulation, manner of articulation, activity of the vocal cords, and allophones. Students completed pronunciation drills focused on Spanish allophones and recorded themselves reading dialogues, which they transcribed phonetically.

L2 learners in Castino's study performed one of two tasks: a reading task and a spontaneous speaking task in which they answered questions on familiar topics and everyday activities. Learners' productions were classified into the following categories and assigned the corresponding score: phonemically incorrect pronunciation (0), phonemically correct but phonetically incorrect (1), and completely correct (2). Castino found significant improvement from the pretest to the posttest on both the reading and spontaneous speaking tasks for all three allophonic variants.[10] Additionally, students who completed the reading task exhibited better pronunciation than those who completed the spontaneous speaking task on both the pretest and the posttest. Castino concluded that the results of his study show that a phonetics course does indeed lead to pronunciation improvement, providing empirical support for previous impressionistic claims.

In a further study on the effect of explicit pronunciation instruction, Elliott (1997) examined L2 learners' acquisition of different phonemes and allophones that are considered the most difficult for native English speakers learning Spanish as a second language and perceived to contribute the most to a foreign accent.[11] Elliott also investigated whether improvement in pronunciation as a result of instruction differed according to task type. Sixty-six L2 learners enrolled in a third-semester intermediate Spanish course participated in the study. Learners were divided into an experimental group (n = 43) that received formal pronunciation instruction and a control group (n = 23)

[10] However, it is not reported whether learners made equal gains on all three sounds as a result of phonetics instruction. It is possible that they made bigger gains on certain, but not all, target sounds, as González-Bueno (1994) found for voiceless and voiced stops.

[11] The sounds under investigation in this study are the Spanish tap and trill, voiced approximants, voiced stops, voiceless stops, palatal nasal, all five vowels, and the allophones [z] and [m]. However, given the focus of the present study, only the results for voiced stops and approximants are discussed.

that did not receive such instruction.[12] Learners completed four tasks (word repetition, sentence repetition, word reading, and picture description) at the beginning of the semester before the experimental group received formal instruction and at the end of the semester.

Elliott found that overall improvement in pronunciation as a result of instruction differed according to task type, as learners in the experimental group significantly improved their pronunciation from the pretest to the posttest on the word repetition, sentence repetition, and word reading tasks, but not on the picture description task.[13] This finding supports the claims of Major's (1986a, 1987d) Ontogeny Model (OM), Major's (2001) Ontogeny Phylogeny Model (OPM), and Tarone's (1979) Chameleon Model that learners' production accuracy is greater in more formal or careful styles of speech, which show less transfer phenomena than informal tasks. Elliott (1997) found more transfer errors in the most informal picture description task in the form of "retroflexion of the Spanish tap and trill, diphthongization of Spanish vowels, vowel lengthening, and the use of stops in [approximant] environments" (p. 102).

Elliott also found that certain sounds benefited more from explicit instruction, as learners in the experimental group significantly improved their pronunciation of [d] and [β], but not of the other voiced stops and approximants. Citing Jakobson (1968) who

[12] Instruction consisted of 10 to 15 minute periods of practice during 21 class meetings. Students learned to describe sounds in their own words that corresponded to the terms used in articulatory phonetics (point, place, and manner of articulation) and drew facial diagrams indicating where they believed the tongue would make contact when producing each sound. Learners used their descriptions to contrast the Spanish sounds with their English counterparts. They also completed pronunciation drills, such as word and sentence repetitions, rhymes, and tongue twisters.

[13] The experimental group's improvement on the picture description task from the pretest to the posttest approached statistical significance ($F = 3.79$, $p < .056$).

claimed that "fricatives are more marked than their stop counterparts and consequently are more difficult to acquire" (p. 102), Elliott (1997) proposed that markedness may explain learners' overall difficulty with the voiced approximants. Although students in the experimental group successfully produced [β ð γ] and made significant gains on [β] on the word repetition and sentence repetition tasks, they were less accurate on the word reading and picture description tasks. Similar to Zampini (1994), Elliott found that orthography negatively affected learners' performance on a reading task. Both groups of learners were most accurate producing [b], but least accurate producing its corresponding approximant allophone [β] when both sounds were represented orthographically as "b". Additionally, learners usually produced a voiced labiodental fricative [v], indicating L1 transfer from English, for orthographic "v" whether the target allophone was a stop or approximant. In summary, similar to the results of González-Bueno (1994), the results of Elliott (1997) show that intermediate learners of Spanish do benefit from formal pronunciation instruction; however, they do not make equal gains on all L2 sounds.

More recently, Lord (2005) investigated the effect of explicit instruction on L2 acquisition of Spanish voiced approximants.[14] Similar to the L2 learners in Castino (1996), the 17 L2 learners that participated in Lord's study were enrolled in an upper-division Spanish phonetics course.[15] Learners read a paragraph from a Spanish novel from which seven tokens of [β], ten of [ð], and six of [γ] were extracted. They completed

[14] Lord (2005) also investigated L2 acquisition of Spanish voiceless stops, the trill /r/, and diphthongs, but only the results for the voiced approximants are discussed.
[15] Phonetics instruction consisted of "textbook explanations of different articulations of English and Spanish sounds, oral practice, transcription practice, and practice with voice analysis with the use of computer software" (Lord, 2005, p. 561).

this task twice during the semester: before receiving phonetics instruction (pre-treatment recording) and at the end of the semester following instruction (post-treatment recording).

Lord found that learners in the experimental group significantly improved their production of all three voiced approximants from the pre-instruction to the post-instruction periods. Learners' accuracy of [β] increased from 44% to 66%, accuracy of [ð] increased from 34% to 48%, and accuracy of [ɣ] increased from 28% to 53%. The results therefore confirmed Lord's hypothesis that explicit instruction aids learners in improving their pronunciation of L2 sounds. However, the lack of a control group of L2 learners who did not receive explicit instruction makes it difficult to draw a definitive conclusion about the effect of such instruction on learners' improvement. As Lord (2005) states, it cannot be "concluded with certainty that the gains evidenced throughout the semester are in fact a result of the phonetics class, as opposed to simply another semester of exposure to advanced-level Spanish or practice with the treatment itself" (p. 565).

Lord (2010) further investigated the effect of explicit instruction in combination with immersion in a target language (TL) community on L2 acquisition of the Spanish voiced stop/approximant distinction. Eight learners at an intermediate proficiency level (in their third- or fourth-year of Spanish study) who participated in a two-month study abroad (SA) program in Mexico participated in the study. Half of the students had completed a Spanish phonetics and pronunciation course prior to the SA program (instruction group), while the other half had not taken such a course prior to going abroad (no-instruction group). Learners read aloud a list of words and phrases in Spanish

containing one of the target sounds [b d g β ð γ]. They completed this task the week prior to departure and upon completion of the SA program.

Lord found that, as hypothesized, both groups of learners correctly produced the voiced stops in all required contexts both pre- and post-immersion. Conversely, both groups of learners' accuracy of voiced approximants was quite low on both the pretest and posttest. However, despite their low accuracy pre- and post-immersion, learners' accuracy did increase after the SA program. Learners in the no-instruction group increased their accuracy of the three allophones from 3.3% on the pretest to 5.8% on the posttest, while learners in the instruction group increased their accuracy from 8.6% to 28.7%. Moreover, this increase in accuracy from the pre- to post-immersion periods was significant for both groups, suggesting that SA is helpful for improving pronunciation of L2 sounds. Lord (2010) notes that although both groups of learners improved significantly, "the instruction group retained its superiority after the program, as the two groups' accuracy rates remained significantly different from each other after immersion" (p. 496). In conclusion, the results of this study show that immersion in a TL community through a study abroad program does have a positive effect on L2 learners' acquisition of Spanish voiced approximants, but the combination of an immersion experience and explicit instruction leads to even more improvement in pronunciation of these L2 sounds.

Kissling (2013a) is the most recent study to examine the effect of explicit instruction on L2 acquisition of Spanish voiced approximants; however, unlike previous studies on this topic, Kissling is the first study to investigate its effect on learners'

productive and perceptive abilities.[16] Ninety-five students enrolled in one of the following three Spanish as a foreign language (FL) courses participated in the study: 1) first-year introductory level, 2) second-year intermediate conversation, and 3) third-year advanced conversation. Kissling employed a pretest, posttest, delayed posttest design and randomly assigned learners to one of two instructional conditions: experimental in which explicit instructional intervention was provided or control in which implicit instructional intervention was provided. The experimental group (+PI) received phonetics instruction via online modules that explicitly taught articulatory phonetics and production of L2 sounds. Conversely, learners in the control group (-PI) received exposure to and practice with L2 sounds more implicitly through short video clips of Spanish native speakers they watched to complete a dictation. Learners first completed the production task, which was an oral reading of a list of Spanish words and phrases. Learners' productions of [β ð γ] were analyzed acoustically using Praat, and assigned a score of one to three according to their auditory and acoustic properties.[17]

Kissling found that overall learners in both instructional conditions at all three curricular levels were not very successful in producing [β] on the pretest, posttest, or delayed posttest, as the highest mean score obtained was 1.60 by third-year +PI learners on the posttest. The highest mean score obtained for [ð] was 1.83 by third-year –PI learners on the delayed posttest, while the highest mean scored obtained for [γ] was 1.81

[16] Kissling (2013a) also investigated acquisition of voiceless stops and rhotics, but only the results for the voiced approximants are discussed.

[17] "Productions were assigned 3 points if they demonstrated all the auditory and acoustic properties associated with their Spanish pronunciation, 1 point if they demonstrated all the auditory and acoustic properties that are associated with an English-accented pronunciation, and 2 points if they demonstrated a combination of the auditory and/or acoustic properties of both languages" (Kissling, 2013a, p. 46).

by third-year –PI learners on the posttest. The only +PI learners that made gains on [β] from the pretest to the delayed posttest were third-year learners, while first- and second-year –PI learners also made gains on this sound from the pretest to the delayed posttest. First-year –PI, second-year +PI and –PI, and third-year –PI learners made gains on [ð] from the pretest to the delayed posttest. First-, second-, and third-year +PI, and second-year -PI learners made gains on [γ] from the pretest to the delayed posttest, while third-year –PI learners made gains on [γ] from the pretest to the posttest. However, despite this observed improvement, only the small gains on [ð] for learners in both instructional conditions from the posttest to the delayed posttest were significant. Based on the results of the production task and the statistical analysis, Kissling (2013a) concluded that "the approximants did not seem to improve with experience across matriculation levels prior to instruction and did not improve following instruction" (pp. 68-69). In summary, neither instructional condition was effective in increasing learners' production accuracy of [β ð γ].

In order to investigate the effect of formal instruction on L2 learners' perceptive abilities, subjects in Kissling's study also completed a discrimination and an identification task. For the discrimination task, learners heard two recordings: one containing the Spanish target sounds (i.e., voiced approximants) and the other their analogous English counterparts (e.g., [eβe] containing the Spanish voiced bilabial approximant vs. [ebe] containing the English voiced bilabial stop). If learners perceived the recordings to sound the same, they were instructed to choose same on an answer sheet; but if they perceived the recordings to sound different, they were instructed to

choose different. Correct responses were assigned 1 point and incorrect responses were assigned 0 points.

Learners significantly improved their discrimination of [ð]/[d] and [ɣ]/[g] over time. Additionally, learners in the +PI group improved their discrimination of [β]/[b] more than those in the –PI group during the course of the study as a result of the explicit instruction they received. However, the differences in improvement between instructional conditions over time for the other approximant/stop pairs were not significant. The interaction between matriculation level and time and between time, instructional condition, and matriculation level were not significant for any sound pairs. In summary, although the +PI group outperformed the –PI group on [β]/[b], phonetics instruction did not provide +PI learners an advantage over –PI learners on the other L2/L1 allophone pairs. Therefore, the results of the discrimination task suggest that explicit instruction is not necessarily more effective than implicit methods in increasing learners' discrimination accuracy since both groups of learners improved their discrimination of Spanish voiced approximants during the course of the study and +PI learners only outperformed –PI learners on one of the three target sound pairs.

For the identification task, learners heard Spanish-like nonce words and typed what they heard in standard Spanish orthography. Learners' spelling of words containing target sounds was assigned a score of 1 or 0. Kissling (2013a) notes that:

> 1 point was assigned to spellings that were non-standard yet indicated that the learner had likely perceived the target sound correctly (e.g., "b" and "v" were

accepted for [β], "d" and "th" for [ð], and "g" or "gu" before "e" or "i" for [γ]). (p. 93)

Overall, learners were most accurate in identifying [β], followed by [γ], and [ð] on the pretest (93%, 81%, and 59% accuracy, respectively). Unsurprisingly, learners made the biggest gains in identification on [ð], followed by [γ], and [β] from the pretest to the posttest and from the pretest to the delayed posttest. Moreover, learners' gains on [ð] from the pretest to the posttest were significantly greater than those on [γ] and [β], and their gains on [β] were significantly lower than those on [ð] and [γ] from the pretest to the delayed posttest.

Kissling (2013a) found "a main effect of time for all phones" (p. 112), indicating that learners' identification scores for all target sounds changed over time. Conversely, the interaction between time and condition was not significant, indicating that the change over time did not differ according to the learners' instructional condition. Matriculation level also did not influence learners' identification scores, as no significant interactions with level were found. In summary, explicit instruction in Spanish phonetics was not more beneficial than exposure to Spanish sounds through dictation exercises, as +PI learners did not make more significant gains in identification accuracy of [β ð γ] than –PI learners. The results of both the discrimination and identification tasks suggest that while L2 learners certainly do benefit from the formal instruction they receive in phonetics courses, learners can still improve their perception of L2 sounds without such explicit instruction.

Finally, Kissling (2013a) also tested the hypothesis that learners' ability to perceive L2 sounds is related to their ability to produce them in addition to investigating whether instruction leads to equal improvement in both L2 productive and perceptive abilities. No significant correlations were found for first-, second-, or third-year learners' performance on the discrimination and identification tasks for any of the voiced approximants. Second-year learners' performance on the discrimination and production tasks was negatively correlated for [β]. Third-year learners' performance on the discrimination and production tasks was positively correlated for [β] and [ɣ]. Finally, first-year learners' performance on the identification and production tasks was positively correlated for [ð]. Kissling's results support the hypothesis that L2 perceptive abilities are related to L2 productive abilities, as a positive relationship was found for each of the target phones.

Whether instruction (either +PI or –PI) was more, less, or equally effective in improving learners' productive or perceptive abilities differed according to learners' matriculation level and the target sound. For [β], first- and second-year learners improved their discrimination of [β]/[b] the most, while third-year learners improved their production of [β] more than their perception. Learners from all levels improved their perception of [ð] more than their production. Only second-year learners' production of [ɣ] benefited from instruction. First-year learners increased their perception of [ɣ] on the identification task more than the other two groups of learners, who improved more on the discrimination task. When learners' matriculation level and performance on a particular sound are considered together, the results suggest that learners improved their perception

of [β ð γ] post-instruction more than their production, as more groups of learners improved their perception of individual target allophones more than their production.

2.3 Context of Learning

Another extralinguistic factor that has received considerable attention in L2 acquisition studies of voiced stops and approximants by native English speakers is context of learning. Stevens (2000) was the first study on L2 Spanish phonology to investigate the effect of context of learning on native English-speaking L2 Spanish learners' acquisition of the voiced approximant allophones. Twenty-two university-level learners of Spanish divided into three groups participated in the study. The at-home (AH) group was comprised of 13 students enrolled in a second-semester Spanish course. The study abroad (SA) group was subdivided into two groups of learners that studied in Madrid, Spain for varying lengths of time. One SA group was comprised of five learners enrolled in an intermediate-level fifth-semester Spanish course in Madrid during a seven-week summer program, while the other SA group consisted of four learners enrolled in upper-division courses in Madrid during a sixteen-week semester program. All learners performed two speaking tasks, a word list reading and a picture description, during a pretest and a posttest.

Stevens found that all three groups' mean accuracy scores increased significantly from the pretest to the posttest. However, this improvement was significantly greater for the two SA groups compared to the AH learners, and the Madrid semester learners improved their pronunciation of [β ð γ] the most. In addition, the results for each

individual allophone also show that the SA learners generally outperformed the AH learners. For [β], although both the Madrid summer and semester learners made significant gains from the pretest to the posttest, while the AH learners did not, the Madrid summer learners improved the most. All three groups improved their pronunciation of [ð] from the pretest to the posttest, but only the AH learners improved significantly. Both Madrid groups increased their pronunciation accuracy of [γ] from the pretest to the posttest, but only the Madrid summer learners improved significantly. Finally, while both SA groups improved their pronunciation of [γ], the AH learners did not, as their accuracy decreased from the pretest to the posttest. The results of Stevens' study suggest that study abroad leads to improvement in L2 Spanish pronunciation of [β ð γ], as the SA learners improved their pronunciation of these sounds significantly more than the AH learners.

Díaz-Campos (2004) further investigated the effect of context of learning on L2 learners' acquisition of Spanish voiced approximants in 20 L2 learners enrolled in Spanish classes at their home university and 26 L2 learners participating in a ten-week study abroad (SA) program in Alicante, Spain. Both groups of students averaged an intermediate-low level of proficiency according to the results of an OPI. Learners read a short text containing words with intervocalic voiced approximants at the beginning (entrance recording) and end (exit recording) of the semester. Neither group of learners received any explicit phonetics instruction between the two recordings.

Díaz-Campos found that overall only 13% of learners' productions of voiced approximants were target-like, while 87% were non-target-like. Moreover, learners'

accuracy improved little from the pretest to the posttest. SA learners' accuracy increased from 10% to 14%, while at-home (AH) learners' accuracy increased from 13% to 16%. Neither of these small increases in accuracy over time was statistically significant. Díaz-Campos posits that learners' lack of significant gains may be attributed to markedness (Eckman, 1987), as voiced approximants are more marked than other sounds, such as stops, and are therefore more difficult to acquire. While Stevens (2000) found that the SA learners in his study improved their pronunciation of [β ð γ] significantly more than AH learners, Díaz-Campos (2004) did not.

In a further study on the effect of context of learning on L2 acquisition of Spanish voiced approximants, Díaz-Campos (2006) examined the interaction between speech style, via two tasks of differing formality, and context of learning.[18] Overall, only 13% and 28% of learners' productions were target-like on the formal task and informal task, respectively, indicating that regardless of speech style learners' production of intervocalic voiced approximants is non-target-like the majority of the time. The finding that overall, learners' productions were more target-like on the informal conversational task contradicts the claim of Tarone's (1979) Chameleon Model, Major's (1986a, 1987d) OM, and Major's (2001) OPM that learners' production accuracy increases as they move towards more careful or formal styles of speech, such as that produced during a reading task. It is possible that learners' production accuracy was lower on the reading task because they were negatively influenced by orthography (i.e., the visual cue of the letter

[18] The methodology employed in Díaz-Campos (2006) is the same as that in Díaz-Campos (2004). The formal task was the same reading task on which the results of Díaz-Campos (2004) are based. The informal data come from two-minute extracts of OPIs.

could have reinforced stop productions in sounds that should have been realized as approximants, such as the intervocalic [d] in "todo").

The results of the analysis of the effect of context of learning reveal that AH learners (37% accuracy) produced voiced approximants more accurately than SA learners (11% accuracy). Díaz-Campos (2004, 2006) hypothesizes that the AH learners outperformed the SA learners in both studies because some AH learners had been studying Spanish longer than SA learners. Finally, the results of the interaction between context of learning and speech style reveal that AH learners' accuracy was greater on the informal task (54%) than the formal task (15%), while SA learners' accuracy was slightly greater on the formal task (12%) than the informal task (10%). Since SA learners have more opportunities than AH learners to use Spanish in more informal, conversational settings, it is unexpected that AH learners' accuracy of approximants in the conversational style would be greater than that of SA learners. Díaz-Campos (2006) attributes this unexpected finding to "the effect of formal language instruction since there is a group within the regular classroom students with seven or more years of language instruction who favor target-like variants" (p. 35). In conclusion, similar to the results of Díaz-Campos (2004), the results of this study suggest that SA does not provide students an advantage over AH students in attaining a more target-like pronunciation of Spanish voiced approximants.

It is not yet possible to draw a definitive conclusion about the effect of context of learning on L2 acquisition of Spanish voiced approximants, as the results have been mixed. The results of Díaz-Campos (2004, 2006) suggest that it is possible to improve

pronunciation of these sounds without SA, as AH learners consistently outperformed SA learners. Unlike Díaz-Campos (2004), Lord (2010) found a significant increase in SA learners' accuracy of voiced approximants over time. However, one of the SA groups in Lord's study had taken a Spanish phonetics course prior to going abroad, so the improvement in that group was due to both the immersion experience and the explicit instruction they had received earlier. Stevens (2000) also found a significant increase in SA learners' pronunciation of [β ð γ]. In summary, while the learners in Díaz-Campos (2004, 2006) did not make gains in their pronunciation of approximants as a result of SA, the learners in Stevens (2000) and Lord (2010) did. Perhaps the results of the most recent studies on context of learning, Alvord and Christiansen (2012) and Rogers and Alvord (2014), will shed new light on its effect on L2 acquisition of Spanish voiced approximants.

Unlike previous studies on context of learning, Alvord and Christiansen (2012) investigated acquisition of Spanish voiced approximants by L2 learners with relatively little formal Spanish instruction and no phonetics instruction who were abroad for an extended period of time.[19] The researchers also examined the influence of other non-linguistic factors (e.g., speech style, prayer in Spanish, music instruction, prior Spanish instruction, time with English-speaking companion, Spanish spoken with English-speaking companion, time spent studying Spanish each day, cultural integration, cultural sensitivity, attitude, and motivation) on learners' acquisition of these sounds. Thirty-four

[19] "Most participants had received some Spanish instruction prior to going abroad in either junior high or high school, while only two had taken one semester each at the university level. All participants had 8 weeks of Spanish instruction immediately prior to departure" (Alvord & Christiansen, 2012, p. 246).

L2 learners who recently returned from a two-year religious missionary experience in a Spanish-speaking country participated in the study. Participants completed two tasks of differing formality; learners first read a short story (less formal task) followed by a word list (more formal task).

Alvord and Christiansen found high overall accuracy rates, as learners produced voiced approximants in a target-like fashion 81% of the time. Learners' overall accuracy did vary slightly by target sound, as 86% of their productions of [ð] were target-like, 77% of their productions of [β] were target-like, and 76% of their productions of [γ] were target-like. Learners' accuracy was slightly higher on the story reading (82%) than on the word list reading (80%), but this difference between the two speech styles was not significant. When comparing individual target sounds across styles, only the productions of [β] were significantly different, as it was produced significantly more accurately on the story task (82%) than on the word list task (72%).

While speech style overall did not have a significant effect on target-like pronunciation of [β ð γ], the following non-linguistic factors did: cultural integration, speaking Spanish with an English-speaking companion, music instruction, previous Spanish instruction, and motivational intensity. Learners who were better integrated into the target culture exhibited a more target-like pronunciation. The amount of Spanish spoken with another English-speaking companion inversely affected target-like pronunciation, as less Spanish spoken with an English-speaking companion favored a target-like pronunciation. Learners with five or more years of music instruction at some point in their life exhibited a more target-like pronunciation than those with less than five

years of music instruction. Learners with the least amount of previous Spanish instruction exhibited the most target-like pronunciation, while those with the most (more than two years) were least accurate in their pronunciation of [β ð γ]. Finally, highly motivated learners favored target-like pronunciation. In conclusion, the results of this study show that it is possible to attain a target-like pronunciation of [β ð γ] with an extended stay abroad despite little prior Spanish language instruction.

Rogers and Alvord (2014) is the most recent study on L2 acquisition of intervocalic Spanish /b d g/ by native English speakers, investigating the effects of context of learning as well as motivational intensity, task type, phoneme type, and word position on acquisition. Unlike previous L2 acquisition studies that impressionistically examined the Spanish stop/spirant alternation, Rogers and Alvord empirically studied the degree of spirantization that learners achieve when compared to native speakers by measuring the valley of the consonant along the intensity curve in Praat v.5.3.22 (Boersma & Weenik, 2012) signal-processing software and subtracting it from the peak of the following vowel. Two groups of adult learners from different levels of instruction participated in the study; the first group (UL learners) was comprised of four learners who had studied Spanish for two years at the university level, while the second group (AB learners) was comprised of four learners who had spent approximately two years in Spanish-speaking countries as religious missionaries like the learners in Alvord and Christiansen's (2012) study. One native speaker from each of the following countries: Chile, Colombia, and Paraguay also participated in the study. All participants completed two speaking tasks of differing formality. The most formal task was an oral reading of a

fictional story in Spanish, while the least formal task was an interview modeled on ACTFL's OPI guidelines.

Rogers and Alvord found that of the three groups of participants in their study, native Spanish speakers spirantized intervocalic /b d g/ the most, as expected, with an overall intensity difference median of 3.86 dB. The AB learners' overall intensity difference median of 6.24 dB was higher than the native speakers', but lower than the UL learners' overall intensity difference median of 13.53 dB. In addition, level of instruction/time abroad was the most significant factor, as AB learners spirantized much more than the UL learners and even completely deleted intervocalic tokens in some cases, in line with the native speakers' production, while UL learners did not. The results therefore suggest that extended time abroad can improve learners' production of the voiced approximant allophones, supporting Alvord and Christiansen's (2012) findings. Task formality was also positively and significantly related to intensity difference, as greater task formality resulted in greater intensity differences and thus less spirantization. Learners were therefore more accurate in producing the voiced approximants in the less formal task. Phoneme type and word position also significantly affected learners' production, while motivational intensity did not. While previous L2 acquisition studies have treated the Spanish stop/approximant contrast as a binary phenomenon, Rogers and Alvord's findings provide empirical evidence that it is actually a gradient phenomenon and further support for studies that previously documented this in L1 Spanish.

2.4 Speech Style

Zampini (1994) examined the effects of speech style and native language transfer on L2 acquisition of Spanish voiced stops and approximants by native English speakers. Seventeen students enrolled in a second-semester intensive Spanish course and 15 students enrolled in a fourth-semester intensive Spanish course participated in the study. Participants completed two tasks of differing formality; learners answered questions about student and university life (informal task) and read a passage from an intermediate culture text (formal task). Focusing on task formality, Zampini tested the following two hypotheses: 1) learners' errors would be due to L1 transfer, and 2) learners would exhibit better pronunciation of Spanish /b d g/ on the informal conversational task than the formal reading task. Although Zampini's second hypothesis contradicts Tarone's (1979) and Major's (1986a, 1987d, 2001) claim that accuracy increases as speech becomes more formal, she predicted more target-like pronunciation on the informal task because voiced stops in English occasionally spirantize in informal speech.

Zampini did not find a significant difference between the second- and fourth-semester students' production of target sounds, indicating that curricular level did not affect acquisition. Both groups of learners more accurately produced voiced stops than voiced approximants, as their accuracy for the stops was near or above 50% on both tasks. Conversely, neither group's accuracy for the voiced approximants approached 50%, as the highest percentage achieved was 32.03% for [β] by fourth-semester students on the conversational task. In many cases, learners' errors and low accuracy were attributed to L1 transfer from English. For example, Zampini (1994) found that "all

mispronunciations of [b] involved the pronunciation of a voiced labiodental fricative [v] in words containing an orthographic "v"' (p. 476). Moreover, learners typically produced stops in phonetic environments that required their approximant allophones and some mispronunciations of [β] involved the production of [v] in words containing orthographic "v", providing further evidence of L1 transfer. These errors occurred more on the reading task than the conversational task, contradicting Tarone's (1979) and Major's (1986a, 1987d, 2001) prediction that L1 transfer errors will appear less frequently in formal than informal speech. It is therefore not unexpected that both groups of learners produced target sounds more accurately on the informal than formal task, confirming Zampini's second hypothesis, but contradicting Tarone's (1979) and Major's (1986a, 1987d, 2001) claim that accuracy increases as speech becomes more formal. While Tarone's and Major's claims generally hold, in this case there is another factor involved, orthography, that is affecting learners' accuracy.

Although not the main focus of her study, Shively (2008) also investigated the effect of speech style as well as other extralinguistic variables on L2 acquisition of [β ð γ] in addition to the effect of orthography and prosody. Other extralinguistic variables included in the analysis were class level, age of first exposure to Spanish instruction, amount of Spanish instruction, time spent abroad, amount of out-of-class contact with Spanish, gender, and learner concern with pronunciation. Nineteen students enrolled in a second-semester Spanish course and seventeen students enrolled in a Spanish Phonetics course participated in the study. Participants completed two speaking tasks: a passage reading and a word list reading.

Learners enrolled in the phonetics course significantly outperformed second-semester learners on both tasks. Students in the phonetics course accurately produced voiced approximants 50% of the time on the passage reading and 42% of the time on the word list reading, while students in the second-semester course accurately produced target sounds 13% of the time on the passage reading and 7% of the time on the word list reading. Although both groups of learners produced [β ð γ] more accurately on the less formal passage reading, the difference in accuracy between the two tasks was only significant for second-semester learners. Moreover, age of first exposure to Spanish, amount of formal instruction, time spent abroad, amount of out-of-class contact with Spanish, and concern with pronunciation also had a significant effect on target-like pronunciation of [β ð γ]. Shively also found that learners produced approximants significantly more accurately when they were in the onset of unstressed rather than stressed syllables.[20] Finally, similar to Zampini (1994), Shively also found evidence of L1 transfer and an effect of orthography on learners' low accuracy of [β], as frequent mispronunciations of this sound involved words spelled with "v".

In summary, the results of studies on the effect of speech style have been quite consistent, as Zampini (1994), Díaz-Campos (2006), Shively (2008), Alvord and Christiansen (2012), and most recently Rogers and Alvord (2014) found that learners produced voiced approximants more accurately on informal than formal tasks. Although

[20] This difference was significant when both groups of learners were analyzed together on each individual task and on the two tasks combined. The results for each class level analyzed separately were different. Although second-semester students were more accurate when target sounds were in the onset of unstressed than stressed syllables on each individual task and on the two tasks combined, the differences were not significant. Conversely, phonetics students produced approximants significantly more accurately in the onset of unstressed syllables on each individual task and on the two tasks combined.

differences in accuracy between formal and informal tasks did not always reach statistical significance for all three target sounds (Alvord & Christiansen, 2012; Zampini, 1994) and all groups of learners (Shively, 2008), learners consistently exhibited more target-like pronunciation of [β ð γ] in informal than formal tasks, contrary to the predictions of Tarone (1979) and Major (1986a, 1987d, 2001) but in line with the prediction of Zampini (1994).

2.5 L2 Production and Perception of Spanish Voiced Stops and Approximants

Unlike the studies previously discussed, González-Bueno (1995) and Face and Menke (2009) examined learners' production of voiced approximants independent of the effects of extralinguistic variables. Five students enrolled in a fourth-semester intermediate conversation course participated in González-Bueno's study. González-Bueno elicited spontaneous speech from learners through interviews administered at the beginning of the semester. Overall, learners produced approximants correctly 51.5% of the time. Learners' accuracy varied according to sound, as they were most accurate in producing [γ] (67.7% accuracy), followed by [β] (59.8% accuracy) and finally, by [ð] (26.7% accuracy).[21] [22] Based on learners' overall accuracy, González-Bueno (1995) concludes that learners are "midway in the acquisition process of these allophones" (p. 74).

[21] González-Bueno posits that learners may have produced [γ] most accurately because it was found in the least amount of obligatory contexts (just 55 compared to 156 for [β] and 137 for [ð].
[22] González-Bueno partially attributes learners' low accuracy on [ð] to L1 transfer, as they produced the English alveolar flap for [ð] 32.2% of the time. Orthography also had a negative effect on learners' production of [ð] since it is represented by the digraph "th" in English, but by the letter "d" in Spanish.

Face and Menke (2009) investigated the effects of orthography and linguistic variables, word position and syllable stress, on L2 acquisition of Spanish voiced approximants by students enrolled in a fourth-semester Spanish course (*n* = 20), graduating Spanish majors (*n* = 20), and Ph.D. students (*n* = 13). Participants completed one speaking task, which was a reading of a short story. Face and Menke found that learners' overall production accuracy increased significantly as learner level increased. Fourth-semester learners produced voiced approximants 35.66% of the time, while graduating Spanish majors produced voiced approximants 61.17% of the time, and Ph.D. students produced voiced approximants 81.06% of the time. Learners' accuracy varied according to sound, as learners from all three levels were most accurate in producing [β], but fourth-semester learners were least accurate in producing [ð] while graduating Spanish majors and Ph.D. students were least accurate in producing [ɣ].

With respect to the effect of orthography, fourth-semester learners produced intervocalic /b/ more often as a stop than an approximant when represented orthographically as "b", while the more advanced groups of learners correctly produced intervocalic /b/ more often as an approximant than a stop when represented orthographically as "b". All three groups of learners produced orthographic "v" as an approximant more often than a stop. L1 transfer as a result of influence of orthography was observed in the fourth-semester learners and graduating Spanish majors, as they produced orthographic "v" as a fricative 30.53% of the time and 13.13% of the time, respectively.[23] Overall, orthography negatively influenced learners' productions of intervocalic /b/ more when represented orthographically as "b" than "v", as learners'

[23] Ph.D. students did not produce orthographic "v" as a fricative.

productions for orthographic "b" were more un-target-like than for "v".[24] In addition to orthography, Face and Menke found that linguistic variables also influenced learners' productions. Both fourth-semester learners and graduating Spanish majors produced more approximants in unstressed than stressed syllables, but the difference according to syllable stress was only significant for fourth-semester students. Syllable stress did not have a significant effect on Ph.D. students' production of approximants. Finally, learners at all three levels produced more approximants in word-internal than word-initial position.

A final strand of research into L2 acquisition of Spanish voiced stops and approximants by native English speakers has focused on learners' productive and perceptive abilities of these sounds. However, the target sounds under investigation in these studies varies, as Zampini (1998) examined acquisition of /p/ and /b/, while González-Bueno and Quintana-Lara (2011) and Kissling (2013a) examined acquisition of [β ð γ].

Zampini (1998) investigated L2 learners' acquisition of Spanish /p/ and /b/ to test the claim of Flege's (1995) SLM that accurate perception is a necessary precursor to accurate production.[25] Thirteen students enrolled in an advanced Spanish phonetics course completed a production and a perception task. L2 learners read words containing stops in word-initial position embedded in English and Spanish carrier phrases. Although

[24] Fourth-semester learners produced un-target-like productions for orthographic "b" 64.21% of the time compared to 43.16% of the time for orthographic "v". Graduating Spanish majors produced un-target-like productions for orthographic "b" 35.54% of the time compared to 21.21% of the time for orthographic "v". Ph.D. students produced un-target-like productions for orthographic "b" 16% of the time compared to 1.5% of the time for orthographic "v".
[25] Given the focus of the present study, only the results for /b/ are discussed.

the effect of explicit instruction was not the main focus of Zampini's study, learners completed the Spanish speaking task at the beginning, middle, and end of the semester to examine the effect of the phonetics instruction on acquisition of /p/ and /b/. For the perception task, learners listened to the English and Spanish nonce words *pada* and *bada*, which were edited to include varying degrees of prevoicing and voicing lag, creating a continuum of VOTs for the tokens in each language. Learners had to indicate whether each version of each word began with /p/ or /b/. A group of monolingual English speakers and of Spanish-English bilinguals also completed the perception task.

Zampini found that learners' mean VOT for Spanish /b/ did not decrease from the beginning to the middle of the semester and from the middle to the end of the semester, remaining rather constant at all three data collection times. Although learners' mean VOT values for Spanish /b/ were somewhat shorter than for English /b/, the differences were not significant, and they very rarely produced Spanish /b/ with prevoicing. Based on the production results, Zampini (1998) concludes "the prevoicing associated with Spanish voiced stops appears to take longer to acquire than the short-lag VOTs of Spanish voiceless stops" (p. 92).

Overall, Zampini found that both the learners and the two control groups have shorter VOT perceptual boundaries for Spanish than for English. Specifically, Zampini found that L2 learners' English perceptual boundary was initially more similar to that of Spanish-English bilinguals than to that of English monolinguals (i.e., initially, L2 learners' English perceptual boundary was shorter than that of English monolinguals). However, the learners' English perceptual boundary became longer and more English-

like after the phonetics course. L2 learners' Spanish perceptual boundary was initially not significantly different from that of either control group; however, it became more Spanish-like after receiving formal instruction. At the end of the semester L2 learners' Spanish perceptual boundary was significantly different from that of English monolinguals but not from that of Spanish-English bilinguals (i.e., L2 learners' Spanish perceptual boundary was shorter). Based on the perception results, Zampini (1998) concludes that "learners have two separate perceptual boundaries, one for each language, that become even more distinct with training" (p. 94).

Finally, the correlations of the production and perception data with respect to VOT did not reveal a strong relationship between the two. Specifically, the correlation data for Spanish /p/ failed to support Flege's hypothesis that accurate perception is a necessary precursor to accurate production, as some learners with the longest perceptual boundaries also produced some of the shortest VOT values. Zampini (1998) concludes that those results seem to "support an opposing hypothesis, namely, that L2 production may in some cases precede perception. That is, it may be the case that learners do not begin to adjust perceptual boundaries until they have attained accurate production categories" (p. 97). The correlation data for Spanish /b/ did not support either hypothesis that production precedes perception or that perception precedes production. Finally, although Zampini did not find evidence for the hypothesis that inaccurate L2 perception limits L2 production, her results do indicate that formal instruction on Spanish stops has a positive effect on L2 learners' acquisition, as learners consistently reduced their mean VOT for /p/ and shortened their Spanish perceptual boundaries.

More recently, González-Bueno and Quintana-Lara (2011) examined learners' awareness of the spirantization rule of Spanish voiced stops via a production and perception experiment. Six learners each with elementary, intermediate and advanced proficiency levels participated in the study.[26] Participants completed the perception task first in which they listened to Spanish words containing an obligatory phonetic context for spirantization; however, the rule was not applied to all tokens. Learners had to identify each word as correct or incorrect.[27] Subjects then completed the production task, which was an oral reading of a paragraph in Spanish.

González-Bueno and Quintana-Lara found that learners' perception accuracy generally increased as proficiency level increased, with a few notable exceptions. Beginning-level learners had the lowest perception accuracy of the three groups of learners for all three target sounds, with all sounds presenting the same level of difficulty. While advanced learners perceived [β] more accurately than beginning and intermediate learners, intermediate learners perceived [ð] and [ɣ] more accurately than the other two groups. Intermediate learners had the most difficulty perceiving [β] and the least difficulty perceiving [ɣ], while advanced learners had slightly more difficulty perceiving [β] than [ð] or [ɣ].

[26] Two students with advanced proficiency in Spanish had taken a Spanish phonetics course. A comparison of those students' results with those of the other students allowed the researchers to determine whether learners can acquire the spirantization rule without such explicit instruction. Participants who had taken a Spanish phonetics course produced, but not perceived, [β ð ɣ] more accurately than those advanced students who had not taken such a course. However, the differences in production and perception accuracy between these two groups of advanced students were not significant.

[27] It was assumed that learners were aware of the spirantization rule if they selected correct when they heard an approximant in one of its obligatory contexts and incorrect when they heard a stop in a context that required an approximant.

González-Bueno and Quintana-Lara also found that learners' production accuracy of all target sounds increased as proficiency level increased, although greater increases in accuracy were observed from the beginning to intermediate levels than from the intermediate to advanced levels. Moreover, learners' production accuracy varied according to target sound. All three groups of learners were least accurate in producing [ð], while beginning learners were most accurate in producing [ɣ] and intermediate and advanced learners were most accurate in producing [β]. Finally, González-Bueno and Quintana-Lara found that production and perception accuracy of [β] and [ɣ] were similar at all learner levels, while production and perception accuracy of [ð] differed the most, as all learners had more difficulty producing than perceiving [ð]. Based on the results of the production and perception tasks, González-Bueno and Quintana-Lara (2011) conclude that "proficiency level has a direct effect on learners' awareness of the Spanish spirantization rule, as learners at the intermediate level start showing awareness of the rule in perception (for [ɣ] and [ð]) and production (for all target sounds)" (p. 189).

As previously mentioned, Kissling (2013a) is the most recent study to investigate learners' production and perception of Spanish voiced approximants, finding that the relationship between L2 productive and perceptive abilities of [β ð ɣ] varies according to learner level and target sound. Specifically, third-year learners' perception, on the discrimination task, and production accuracy were positively correlated for [β] and [ɣ], while first-year learners' perception, on the identification task, and production accuracy were positively correlated for [ð].

2.6 Summary/Future Directions

Based on the studies reviewed in this chapter, it is apparent that L2 acquisition of Spanish voiced stops and approximants by native English speakers has been investigated quite extensively, as research has focused on learners' productive and perceptive abilities in addition to the effect of orthography and of both extralinguistic and linguistic variables. However, there are certain areas that merit further investigation, as they have received considerably less attention than other areas. Research into L2 acquisition of Spanish voiced stops and approximants by native English speakers has tended to focus exclusively on learners' productive abilities and on acquisition of either voiced stops or approximants, with far fewer studies examining acquisition of both classes of sounds. Moreover, far fewer studies have been carried out on learners' perception of these sounds (González-Bueno & Quintana-Lara, 2011; Kissling, 2013a; Zampini, 1998) and no L2 perception study on the entire Spanish voiced stop series has yet been carried out.

Research into L2 production and perception of Spanish voiced approximants is relatively new (González-Bueno & Quintana-Lara, 2011; Kissling, 2013a), and the results have not always been conclusive. González-Bueno and Quintana-Lara reported learners' errors in producing and perceiving voiced approximants, but did not report whether differences in production and perception accuracy were significant. González-Bueno and Quintana-Lara also reported anecdotally that production and perception accuracy of [β] and [γ] were similar at all learner levels, while production and perception accuracy of [ð] differed the most, as all learners had more difficulty producing [ð], but it is unknown whether these correlations are statistically significant. While it appears that

perception and production of [ð] for the learners in González-Bueno and Quintana-Lara's study would not be significantly correlated, Kissling found a positive correlation between first-year learners' perception, on the identification task, and production accuracy of [ð]. Moreover, Kissling did not find significant correlations between the production task and the same perception task for all three sounds or for all groups of learners.

Since perception studies have lagged behind production studies and studies on both voiced stops and approximants have lagged behind studies on just one class of these sounds, it is not surprising that no L2 study has investigated production and perception of both voiced stops and approximants. The present study aims to begin to bridge this gap in the L2 Spanish phonological acquisition literature by investigating the following question: Does L2 learners' production and perception accuracy differ according to the class of sounds (voiced stops vs. approximants)? Given that the relationship between L2 Spanish learners' productive and perceptive abilities of approximants has only recently begun to be investigated (González-Bueno & Quintana-Lara, 2011; Kissling, 2013a) and researchers have not yet drawn firm conclusions, the present study aims to further investigate the potential relationship between L2 learners' production and perception of voiced stops and approximants by investigating the following questions: Are learners' productive and perceptive abilities related? Is accurate L2 perception necessary for accurate L2 production, or vice versa? Finally, most previous studies on L2 Spanish acquisition of voiced stops and approximants have focused on intermediate-level learners or students enrolled in upper-division Spanish phonetics courses, with far fewer studies investigating acquisition of these sounds at different points in a university curriculum.

Shively (2008), Face and Menke (2009), González-Bueno and Quintana-Lara (2011), and Kissling (2013a) were the only studies to examine acquisition over a considerable amount of time, investigating only acquisition of approximants. The present study aims to investigate acquisition of voiced stops over time in addition to further investigating acquisition of approximants over time through a cross-sectional design by addressing the following questions: How do L2 Spanish learners at different instruction levels produce and perceive voiced stops and approximants? Is there development between levels?

In order to further contextualize the present study on L2 acquisition of the sounds (i.e., voiced stop consonants) associated with allophonic and phonemic contrasts in Spanish and Italian, studies on L2 acquisition of Italian stops are reviewed in the following chapter. The methodology employed in this study is then explained in Chapter 4.

Chapter 3 Review of Studies on L2 Acquisition of Italian Stops

3.1 Introduction

Research into L2 acquisition of Italian stops has lagged behind that into L2 acquisition of Spanish stops. In addition, while there is a long line of research, reviewed in the previous chapter, that has investigated native English-speaking L2 Spanish learners' acquisition of stop consonants, there are comparatively fewer studies on L2 acquisition of Italian stops by native English speakers (Harris, 2010; Rochet & Rochet, 1995). Studies on L2 acquisition of Italian stops have largely focused on learners' productive abilities, with fewer studies investigating learners' perceptive abilities. The majority of L2 acquisition studies examined either production or perception of the singleton/geminate stop contrast (Celata & Costamagna, 2011; Kabak, Reckziegel, & Braun, 2011; Rochet & Rochet, 1995), while other studies investigated acquisition of individual singleton stops (Grassegger, 1991; Harris, 2010). De Clercq, Simon, and Crocco (2014) is the only study to date, to the best of my knowledge, to have investigated L2 learners' production and perception of singleton and geminate stops. Each of these studies are reviewed below.[28]

[28] Even though L2 acquisition of voiceless stops is not examined in this dissertation, many of the studies reviewed in this chapter investigated these sounds (De Clercq et al., 2014; Grassegger, 1991; Harris, 2010; Rochet & Rochet, 1995). These studies are included here because there are so few studies on L2 acquisition of Italian stops (singletons and/or geminates) in general.

3.2 L2 Acquisition Studies on Individual Italian Singleton Stops

Grassegger (1991) was the first study to investigate L2 acquisition of Italian stops, focusing on production and perception of /p/ and /b/. Grassegger examined acquisition of these specific sounds because a previous study (Grassegger, 1988) found that L2 Italian learners with an Austrian variety of German as their L1 have difficulty distinguishing between homorganic voiced and voiceless stops in production. Consequently, Grassegger (1991) investigated production and perception of /b/ and /p/ to determine whether inaccurate perception hinders L2 learners' production of these sounds.

For the perception test, a series of 10 stimuli containing word-initial /p/ or /b/ followed by /a/ with VOT values ranging from -80 ms to +64 ms in 16 ms increments was created. Ten L1 speakers of an Austrian variety of German learning Italian as an L2 and five native speakers from Northern Italy completed the perception task.[29] Subjects heard stimuli that represented the beginning of either "palla" or "balla" and had to indicate which word corresponded to each stimulus. The majority of learners, seven out of ten, incorrectly perceived stimuli with no voicing lead or even with a voicing lag up to about 24 ms as acceptable realizations of the beginning of "balla". The remaining three learners correctly perceived only stimuli with voicing lead as acceptable realizations of the beginning of "balla".[30] However, the stimuli perceived as acceptable realizations of "ba" by native Italian speakers contained greater voicing lead than those deemed acceptable by the three L2 learners.

[29] L2 learners' experience studying Italian ranged from one to four years.
[30] It is not reported whether the differences in perception accuracy between the two groups of L2 learners are due to differences in experience studying Italian, but it is plausible that the group with the greater perception accuracy had been studying Italian longer.

For the production test, L2 learners read the words "palla" and "balla" five times each and Grassegger measured VOT of each stop production. Only the learners that perceived stimuli with voicing lead as acceptable realizations of "ba" produced /b/ with voicing lead, with mean VOTs ranging from -27.8 ms to -37.6 ms. All other learners produced /b/ with voicing lag, with mean VOTs ranging from 18.8 ms to 26.6 ms. All learners produced /p/ with voicing lag, with mean VOTs ranging from 19.8 ms to 38.8 ms.[31] Based on the results of the perception and production tests, Grassegger concluded that L2 learners' perceptive and productive abilities are related, as accurate perception is accompanied by accurate production, confirming his hypothesis. While learners' production and perception of /b/ support this conclusion, it is important however to note that it is difficult to arrive at a definitive conclusion regarding the relationship between production and perception of /p/ and /b/ because the control group of native speakers only performed the perception task, so there was no established target for learners' production accuracy. Moreover, it is unknown if learners' production and perception accuracy were significantly correlated, as no correlation statistics were presented.

More recently, Harris (2010) examined production of /t/ by late bilinguals and native English speakers learning Italian as an L2. Specifically, Harris investigated whether late bilinguals who have been living in Italy for many years exhibited phonetic learning in Italian /t/. She also investigated whether amount of native speaker input affected phonetic learning in the late bilinguals and three groups of L2 learners who have

[31] Unlike the perception test, Grassegger did not include a control group of Italian native speakers that completed the production test, so it is unknown how target-like learners' productions of /p/ and /b/ were. Landi (1995), based on data from 15 native speakers, found that the mean VOT of /b/ is 4 ms and the mean VOT of /p/ is 10 ms. According to these results, the VOT values for /b/ and /p/ of the learners in Grassegger's study would not be considered target-like.

received differing amounts of input from Italian native speakers. Finally, Harris examined whether learners' production of Italian /t/ led to modifications in their production of English /t/. Nine English/Italian bilinguals who were first exposed to their L2 of Italian after the age of 15, immigrated to Italy as adults, and had been living there for at least 15 years participated in the study. Three groups of L2 learners with limited exposure to Italian (LEP beginner, LEP intermediate, LEP advanced) also participated in the study.[32] Participants read Italian and English words containing word-initial /t/ followed by /i/ in similar carrier phrases in each language.

Harris found that VOT for Italian /t/ decreased as amount of native speaker input increased among the three groups of L2 learners. LEP beginners had the highest mean VOT at 77.24 ms, followed by LEP intermediate learners whose mean VOT was 63.60 ms, followed by LEP advanced learners whose mean VOT was 42.89 ms. Surprisingly, late bilinguals' mean VOT for Italian /t/ at 59.98 ms was not the shortest or the most target-like among the four groups of subjects.[33] Moreover, late bilinguals' mean VOT was not significantly shorter than the three LEP groups combined, indicating that they had not achieved more phonetic learning than the other groups. Conversely, LEP advanced learners produced significantly shorter VOTs than the LEP beginner and intermediate learners combined. However, LEP intermediate learners did not produce significantly shorter VOTs than LEP beginner learners, but the difference was approaching

[32] Harris (2010) notes that "7 LEP beginners had been learning Italian for less than 1 year and received less than 4 hours exposure to native Italian speech per week. 6 LEP intermediate participants had been learning Italian for 3-4 years and were exposed to the speech of native Italians for 2-4 hours per week. 7 LEP advanced participants had been learning Italian for more than 7 years and were exposed to native Italian speech for at least 9 hours per week" (p. 61).
[33] LEP advanced learners' mean VOT was the most target-like, as Italian monolinguals' mean VOT was 32.62 ms.

significance. Finally, the difference in VOT between LEP advanced learners and late bilinguals was approaching significance. In summary, when comparing the mean VOTs of all four groups, it is apparent that "phonetic learning did not increase in order of least received native speaker input to most received native speaker input" (Harris, 2010, p. 65), as the group with the most native speaker input, late bilinguals, did not produce the most target-like VOT values. Although native speaker input did not appear to influence production of Italian /t/ in the late bilinguals, it did influence production of the three LEP groups, as significant differences between groups were found. Finally, Harris did not find that phonetic learning in Italian /t/ caused modifications to VOT of English /t/ in either late bilinguals or any group of LEP learners.

3.3 L2 Acquisition Studies on the Italian Singleton/Geminate Stop Contrast

Rochet and Rochet (1995) was the first study to investigate L2 acquisition of the Italian singleton/geminate stop contrast. Specifically, they examined whether consonant duration or vowel duration in the minimal pair *fato* 'fate'/*fatto* 'fact' is more perceptually salient to both native listeners and non-native listeners. Twelve native speakers of Italian and twelve native speakers of English learning Italian as an L2 participated in the study.[34] Subjects heard computer-edited versions of the word *fato* in which vowel duration and consonant duration were manipulated (i.e., vowel duration was decreased and consonant duration was increased incrementally) and had to identify each version of the token as either *fato* or *fatto*.

[34] Rochet and Rochet (1995) note that the Italians were "native speakers of northern Italian enrolled at the University of Bologna and the L2 Italian learners were native speakers of Canadian English enrolled at the University of Alberta" (p. 616).

Rochet and Rochet found that consonant duration was the more perceptually salient cue to the voiceless singleton/geminate stop contrast for native Italian listeners. The results for native English speakers were different. First, native English speakers did not distinguish *fato* from *fatto* in tokens in which only consonant duration was manipulated. Second, native English speakers distinguished *fato* from *fatto* in tokens in which only vowel duration was manipulated in two different ways. Some native English speakers correctly equated a long vowel with a singleton consonant and a short vowel with a geminate consonant, while other native English speakers incorrectly associated a long vowel with a long consonant and a short vowel with a short consonant. In summary, Rochet and Rochet found that native and non-native listeners perceptually distinguish minimal pairs with a voiceless singleton/geminate stop contrast differently, as vowel duration is a more salient perceptual cue to the consonant length contrast for native English speakers, while consonant duration is a more salient perceptual cue for native Italian speakers.

More recently, Celata and Costamagna (2011) investigated acquisition of voiceless and voiced singleton and geminate stops by native speakers of Estonian learning Italian as an L2. However, unlike the learners in previous studies on L2 acquisition of Italian stops, the learners in this study come from an L1 background (Estonian) in which a consonant length contrast, albeit slightly different, is present.[35] Although these learners already have the phonological category of geminates in their L1, acquisition may not necessarily be easier for them, as Estonian has a three-way

[35] Celata and Costamagna note that there are three degrees of phonological length for both consonants and vowels in Estonian: short, long, and super long. Syllable structure determines permissible length oppositions.

distinction in consonant length as opposed to the two-way distinction in Italian. Four native speakers of Estonian with a low level of proficiency in Italian who were enrolled at a university in Perugia, Italy participated in the study. Participants read isolated words and short phrases in Italian in addition to repeating words produced by a native Italian speaker.

A native speaker of Italian also completed the same reading task as the L2 learners, producing both voiceless and voiced geminate stops with a mean duration that was slightly less than double the duration of the corresponding singleton stops.[36] [37] Similarly, L2 learners' mean duration of geminates was slightly less than double the duration of the corresponding singleton stops.[38] Unlike previous studies (e.g., Chang, 2000; Esposito & Di Benedetto, 1999), Celata and Costamagna did not find that the stressed vowel preceding a geminate was shorter than the stressed vowel preceding a singleton in L1 Italian. In some cases, the lengthening of the consonant coincided with a lengthening of the preceding vowel in L1 Italian (e.g., the duration of the vowel preceding /t/ was 174 ms, while the duration of the vowel preceding /t:/ was 275 ms; and the duration of the vowel preceding /k/ was 173 ms, while the duration of the vowel preceding /k:/ was 203 ms). Conversely, but in agreement with the results of previous studies on L1 Italian (Chang, 2000; Esposito & Di Benedetto, 1999), L2 learners

[36] The native speaker's and L2 learners' production of /g/ and /g:/ was not included in the analysis because few tokens of each sound were produced, but all other singleton/geminate stop pairs were included.
[37] Both the mean closure duration and the mean duration of the entire segment was 1.8 times greater in the geminates than in the singletons.
[38] L2 learners' mean closure duration of geminates was 1.8 times greater than that of singletons, while learners' mean duration of the entire segment was 1.7 times greater in the geminates than in the singletons.

consistently produced vowels preceding geminates with shorter durations than vowels preceding singletons. In conclusion, it appears that the consonant length contrast in the learners' L1 (Estonian) facilitated rather than hindered their acquisition of Italian voiceless and voiced singleton and geminate stops, as they produced all sounds in a target-like fashion.

Kabak et al. (2011) examined L2 learners' production of voiceless and voiced singleton and geminate stops to determine whether they can reliably produce consonant length differences in Italian in a native-like fashion. All L2 learners (n = 20) were native speakers of German, which unlike Italian does not employ a consonant length contrast. Learners were evenly divided into two groups based on experience with Italian: naïve group and advanced group.[39] Eight native speakers of Italian from Northern or Northern-Central Italy also participated in the study. Participants repeated nonce words containing target sounds produced by a native speaker of Italian, and before repeating the word had to assign either a feminine (*la*) or masculine (*il*) definite article to the word (e.g., *la tessa*, *il tuppe*).

Across all three groups /g/ and /d/ were the shortest singleton stops followed by /b/, /k/ and /t/, while /p/ was the longest singleton stop. These differences in mean duration were significant. L1 Italian speakers produced singletons with a significantly shorter mean duration (84.5 ms) than advanced learners (96.1 ms) whose mean duration was significantly shorter than that of naïve learners (106.8 ms). Across all three groups voiceless geminates (200 ms) had longer durations than voiced geminates (165 ms). The

[39] Kabak et al. (2011) note that learners in the naïve group had "no prior learning experience with Italian", while learners in the advanced group had "studied Italian between 5 and 10 years in high school and university and/or had lived in Italy between 6 months and 3 years" (p. 995).

naïve learners' production of geminates was not significantly different from that of advanced learners (185 ms for both groups), but both groups produced geminates that were significantly shorter than those produced by native Italian speakers (196 ms). In summary, although both groups of learners distinguished geminates from singletons, as evidenced by their mean durations, their productions were still outside of native speaker norms. Kabak et al. (2011) concluded that "consonantal length contrasts can be maintained even by non-native speakers whose L1 lacks such contrasts although their precise phonetic implementation is difficult to master" (p. 997).

Finally, De Clercq et al. (2014) is the most recent study to investigate L2 learners' acquisition of the singleton/geminate stop contrast in Italian and the only previous study to focus on both learners' production and perception. Specifically, they investigated whether 10 native speakers of Dutch who were beginning learners of Italian distinguished between the following singleton/geminate stop pairs: /p/-/p:/ and /t/-/t:/ in an AXB discrimination task and a reading task.[40] For the perception task, learners heard three stimuli played consecutively and had to decide whether the second stimulus (X; e.g., *note* 'notes') was similar to the first (A; e.g., *notte* 'night') or the third (B; e.g., *note* 'notes') stimulus. The same words used in the perceptual stimuli were used for the production task, as learners read them out loud in a carrier phrase. De Clercq et al. measured closure duration for the singleton and geminate stops in addition to preceding vowel duration in order to calculate the C/V ratio.

[40] De Clercq et al. also investigated L2 acquisition of /s/-/s:/; however, given the focus of the present study, only the results for the singleton/geminate stop pairs are discussed.

L2 learners' perception of all singleton/geminate pairs was quite high, as they accurately perceived a difference between /p/-/p:/ 92.5% of the time and between /t/-/t:/ 96.7% of the time. A native speaker of Italian who completed the same task accurately perceived a difference 97.5% of the time on all three pairs collectively. De Clercq et al. claim that place of articulation could affect learners' discrimination of singletons and geminates, as they more accurately perceived length differences in consonants produced further backwards in the oral cavity, i.e., alveolar /s/ and dental /t/. L2 learners produced geminate stops with longer closure durations than their corresponding singletons, but geminates were not approximately twice as long as singletons, as in the native speaker's production.[41] Similar to the native speaker, L2 learners produced vowels preceding geminates with shorter durations than those preceding singletons; however, the learners' mean duration values were not consistent with the native speaker's norms.[42] Finally, smaller differences were observed in learners' mean C/V ratios for singletons and geminates than in the native speaker's mean C/V ratios. De Clercq et al. concluded that learners do not distinguish between singletons and geminates in a native-like fashion, as their mean closure durations, preceding vowel durations, and C/V ratios were outside of the mean durations and C/V ratios produced by the native speaker.

[41] L2 learners produced singletons with a mean consonant length of 112.9 ms and geminates with a mean consonant length of 184.9 ms, while the native speaker produced singletons with a mean consonant length of 88.2 ms and geminates with a mean consonant length of 226.3 ms.
[42] L2 learners produced vowels preceding singletons with a mean duration of 149.1 ms and vowels preceding geminates with a mean duration of 90.1 ms, while the native speaker produced vowels preceding singletons with a mean duration of 197.6 ms and vowels preceding geminates with a mean duration of 128.9 ms.

3.4 Summary/Future Directions

Since research into L2 Italian acquisition of the singleton/geminate stop contrast is relatively new and it has been studied to varying degrees, there remain gaps to be filled. For example, there is a need for more studies that investigate L2 Italian learners' perception of the singleton/geminate stop contrast. Perception studies have lagged behind production studies, as only two such studies have been carried out (De Clercq et al., 2014; Rochet & Rochet, 1995). While Rochet and Rochet (1995) is an important starting point, our knowledge of L2 Italian learners' perception of the singleton/geminate stop contrast is currently incomplete, as that study investigated only perception of /t/ and /t:/ to the exclusion of the singleton/geminate contrast in the other voiceless stops and in the voiced stops. De Clercq et al. (2014) similarly examined learners' perception of the singleton/geminate contrast only in voiceless sounds, while studies that have focused specifically on acquisition of the singleton/geminate contrast in voiced stops have only examined learners' production. However, in order to arrive at a more complete understanding of L2 Italian learners' acquisition of the singleton/geminate stop contrast, it is necessary to examine both their production and perception of the target sounds. Therefore, the present study focuses specifically on the voiced singleton/geminate stop contrast in part as a result of the lack of attention to these sounds in previous perception studies. Focusing on voiced stops also allows us to further investigate one of the results of De Clercq et al.'s perception experiment. De Clercq et al. found that learners more accurately perceived the length contrast in consonants produced further backwards in the oral cavity, i.e., alveolar /s/ and dental /t/ compared to bilabial /p/, but it is unknown

whether a similar result would be obtained for voiced sounds, specifically for all three voiced stops. It is also unknown why place of articulation would only affect learners' perception of the consonant length contrast without also affecting their production.

Moreover, while L2 Italian learners' production and perception of the singleton/geminate stop contrast have been investigated separately and to varying degrees, the potential relationship between production and perception has not yet been investigated. De Clercq et al. (2014) is the only L2 acquisition study on the Italian singleton/geminate stop contrast, to the best of my knowledge, to investigate both production and perception; however, the researchers investigated production and perception separately, so the potential relationship between learners' productive and perceptive abilities is unknown. The present study aims to begin to bridge this gap in the L2 Italian phonological acquisition literature by investigating the following questions: What, if any, is the relationship between learners' production and perception of voiced singleton and geminate stops? Is accurate perception a necessary precursor to accurate production?

Finally, since previous studies (Celata & Costamagna, 2011; De Clercq et al., 2014; Kabak et al., 2011; Rochet & Rochet, 1995) tend to focus on university-level L2 learners from lower proficiency levels, it is unknown how learners' production and perception of Italian singleton and geminate stops develop over time. The present study aims to begin to bridge this gap by investigating the following questions: How do learners at different levels of Italian instruction produce voiced singleton and geminate

stops? How do learners at different levels of Italian instruction perceive voiced singleton and geminate stops? Is there development between levels?

The methodology employed in the present study is explained in the following chapter. Background information on the participants is first presented followed by a description of the materials used in the study. The perception and production tasks are then described and the data analysis is explained.

Chapter 4 Methodology

4.1 Introduction

The present study entailed a cross-linguistic investigation of second language (L2) learners' pronunciation of the Spanish and Italian voiced obstruents /b d g/ to determine the following:

1. For which group of L2 learners – native English-speaking university students studying Spanish or native English-speaking university students studying Italian – acquisition of the target sounds poses fewer difficulties.
2. The point in the university curriculum – first-, third-, or fourth-year – at which students begin to correctly produce and perceive, if at all, the voiced stop phonemes and their corresponding allophones in Spanish and the voiced singleton and geminate stop phonemes in Italian.
3. Whether perception of the target sounds in the learners' respective L2 influences or is related to production.

In addition to bridging previously mentioned gaps in the respective L2 Spanish and L2 Italian phonological acquisition literatures, the present study aims to begin bridging a gap in the overall L2 phonological acquisition literature by examining acquisition of allophonic and phonemic contrasts by L2 learners. In order to investigate acquisition of these contrasts by L2 Spanish and Italian learners, a combined production and perception experiment was carried out. The methodology employed in this study is discussed in this chapter. Information about the participants is provided in Section 4.2,

while the materials used in the study are described in Section 4.3, the tasks that learners performed are discussed in Section 4.4, and the data analysis is explained in Section 4.5.

4.2 Participants

Native English speakers who are learning either Spanish or Italian as an L2 at the university level were recruited to participate in the present study. 23 L2 Spanish learners and 20 L2 Italian learners participated in the study. In order to examine how L2 learners' acquisition of allophonic and phonemic contrasts develops over time, learners at different instruction levels in the Spanish and Italian curricula at the same university in the Midwestern United States were recruited for the study.[43] Care was taken to control for the number of semesters between each course at the different instruction levels, as learners were recruited from courses with at least one intervening semester. Specifically, students enrolled in the following courses in their respective L2 were recruited to participate in the study: first-year (second-semester) language course, third-year (fifth-semester) composition and conversation course, and fourth-year upper-level elective course on literature, culture, or film.[44] The first-year language course meets four times per week for three hours and 20 minutes each week. The third-year composition and conversation

[43] Although a longitudinal study that follows the same learners over an extended period of time may potentially provide more insight into development of these contrasts over time, such a study was not feasible given the time constraints on this project. Therefore, a reasonable alternative was a cross-sectional study in which acquisition by learners at different points in their language study is investigated.

[44] While there were two intervening semesters between the Spanish and Italian first- and third-year courses, there was only one intervening semester between the Spanish and Italian third- and fourth-year courses, as reported on learners' language background questionnaires, due to the nature of the curricula at this university. Many third- and fourth-year Spanish and Italian learners at this university do not have two semesters between courses because many students take the third-year course and a fourth-year course in the same semester.

course meets two times per week for three hours and 50 minutes each week. Fourth-year upper-level courses on literature, culture, or film meet two times per week for two hours and 30 minutes each week. Comparison of L2 Spanish and L2 Italian learners' phonological acquisition is facilitated by the fact that the Spanish and Italian curricula at this university follow the same sequence through the fifth-semester of study and the upper-level elective courses focus on the same general topics of literature, culture, and film studies and by the fact that the Spanish and Italian courses at each instruction level meet for the same amount of time each week.[45] The data from both L2 learners and native speakers of each language were collected during weeks nine through eleven of the Fall 2015 semester and during weeks three through six of the Spring 2016 semester.

Biographical data were obtained from learners through a questionnaire adapted from Kissling (2013a), which also included questions about previous and current L2 study. L2 Spanish and L2 Italian learner background characteristics are summarized in Tables 1 and 3, respectively, while L2 Spanish and L2 Italian learners' language use

[45] Students enrolled in linguistics courses at the time of the study were not included because the Italian department does not offer any linguistics courses, while the Spanish department offers introductory and more advanced linguistics courses. Therefore, including students from a Spanish linguistics course would make for an unfair comparison with the Italian students since linguistics students' production and perception of target sounds would likely differ from that of other students as a result of the content of linguistics courses. Data gleaned from the background questionnaire allowed the researcher to control for this variable, as learners were asked to report the Spanish courses they had previously taken and the courses they were taking at the time of the study. Although no Spanish students were enrolled in a linguistics course at the time of the study, four of the eight fourth-year L2 Spanish students reported previously taking an Introduction to Hispanic Linguistics course. These students completed this linguistics course either the semester prior to participating in the present study or two to three years prior to participating in the study. In addition, despite briefly studying Spanish phonetics and phonology in this course, these four students indicated on the background questionnaire that they had not previously received instruction on Spanish sounds or pronunciation. Since their production and perception did not differ from the other four fourth-year L2 Spanish learners' production and perception, the students that had previously taken the introductory Spanish linguistics course were included in the study.

outside of the classroom is presented in Tables 2 and 4, respectively.[46] The background questionnaires that L2 Spanish and L2 Italian learners completed are included as appendices 1 and 2, respectively.

Table 1: L2 Spanish learner background characteristics

Level of Spanish instruction	No. of subjects	Age		Gender	
		Range	Mean	Male	Female
First-year	6	18-32	22.7	3	3
Third-year	9	18-20	18.8	2	7
Fourth-year	8	19-22	20.5	4	4

Table 1: L2 Spanish learner background characteristics continued

Level of Spanish instruction	No. of subjects	Age when first began studying Spanish		Years of L2 study completed		Time spent abroad (in weeks)	
		Range	Mean	Range	Mean	Range	Mean
First-year	6	8-32	19.5	.5-6.5	2	0	0
Third-year	9	11-16	13.2	3.5-8	5.8	0-3	.61
Fourth-year	8	5-14	11	5-15	9.8	0-24	7.4

As reported in Table 1, L2 Spanish learners' mean age is similar across the three instruction levels. However, first-year learners first began studying Spanish considerably later than third- and fourth-year learners. In addition, years of L2 Spanish study completed increases across instruction levels. Finally, only third- and fourth-year students have spent time abroad; however, third-year students spent very little time abroad compared to fourth-year students.

[46] L2 learners' background characteristics and language use outside of the classroom are self-reported.

Table 2: L2 Spanish learners' language use, reported in hours per week, outside of the classroom

Level of Spanish instruction	Watch Spanish TV/movies		Listen to Spanish music		Speak Spanish with friends		Speak Spanish at work		Total use outside of class	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
First-year	0-1	.5	0-5	1.8	0-2	.8	0-4	1.5	1-12	4.7
Third-year	0-3	.9	1-6	2.4	0-2	.6	0-1	.1	1-10	4
Fourth-year	0-2	1.1	1-5	2.5	0-2	.8	0-2	.3	1-11	5.6

To summarize, all L2 Spanish learners used, on average, Spanish outside of the classroom the most to listen to music. First-year learners used, on average, Spanish outside of the classroom the least to watch TV and/or movies, while third- and fourth-year learners used it the least outside of the classroom to communicate at work. Overall, L2 learners' total Spanish use outside of the classroom was quite similar across instruction levels, increasing slightly from the first- to the fourth-years and from the third- to the fourth-years while decreasing slightly from the first- to the third-years.

Table 3: L2 Italian learner background characteristics

Level of Italian instruction	No. of subjects	Age		Gender	
		Range	Mean	Male	Female
First-year	8	19-26	20.4	4	4
Third-year	6	19-22	21	3	3
Fourth-year	6	18-32	22.3	2	4

Table 3: L2 Italian learner background characteristics continued

Level of Italian instruction	No. of subjects	Age when first began studying Italian		Years of L2 study completed		Time spent abroad (in weeks)	
		Range	Mean	Range	Mean	Range	Mean
First-year	8	18-25	19.5	.5-.7	.5	0-8	1
Third-year	6	10-19	17	2-7	2.8	1.5-20	10.1
Fourth-year	6	14-25	17.8	2-7	3.6	0-130	31.5

As reported in Table 3, L2 Italian learners' mean age is similar across the three instruction levels, increasing slightly from the first- through the fourth-years of study. Similar to the L2 Spanish learners, first-year L2 Italian learners first began studying Italian later than third- and fourth-year learners. In addition, consistent with the Spanish learner background data, years of L2 Italian study completed increases across instruction levels. Time spent abroad similarly increases across instruction levels, with third- and fourth-year learners spending on average the most time abroad.

Table 4: L2 Italian learners' language use, reported in hours per week, outside of the classroom

Level of Italian instruction	Watch Italian TV/movies		Listen to Italian music		Speak Italian with friends		Speak Italian at work		Total use outside of class	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
First-year	0-2	.5	0-1	.4	0-2	.8	0	0	0-5	1.9
Third-year	0-1	.3	0-3	.7	0-4	1.3	0-1	.2	0-8	2.5
Fourth-year	0-4	1.8	0-6	2	0-2	1	0	0	2-10	5.2

To summarize, first- and third-year L2 Italian learners used, on average, Italian outside of the classroom the most to communicate with friends, while fourth-year learners used, on average, Italian outside of the classroom the most to listen to music. Conversely, all learners used Italian outside of the classroom the least to communicate at work. Finally, L2 learners' total Italian use outside of the classroom increased across instruction levels.

Four native speakers of Spanish and five native speakers of Italian also participated in the study to provide a basis of comparison for the L2 learners' production and perception data.[47] Native speaker participants were instructors, faculty, and Ph.D. students teaching and studying at the same university as the L2 learners. Biographical data were obtained from the native speakers of Spanish and Italian through a questionnaire adapted from Kissling (2013a), and are summarized in Tables 5 and 6,

[47] Data were collected from five native speakers of Spanish; however, the fifth native speaker was excluded from the analysis because his production of target approximants was quite different from that of the other four native Spanish speakers, as he produced just four target approximants as such and the remaining 26 as stops.

respectively. The background questionnaires that native Spanish speakers and native Italian speakers completed are included as appendices 3 and 4, respectively.

Table 5: Native Spanish speakers' background characteristics

Speaker	Age	Gender	Birth Country	Time living in US (years)
1	58	Female	Puerto Rico	39
2	31	Female	Colombia	6
3	44	Male	Spain	20
4	40	Female	Chile	16

As reported on the background questionnaire, all native Spanish-speaking participants heard and used only Spanish between the ages of 0 and 5. Only one native speaker had completed a Spanish phonetics and phonology course as part of her graduate studies. In addition to English and Spanish, all of the native Spanish speakers reported speaking other, mainly Romance, languages including French, Portuguese, and Italian.

Table 6: Native Italian speakers' background characteristics

Speaker	Age	Gender	Birth Region	Time living in US (years)
1	51	Female	Piemonte (Northern Italy)	14
2	51	Female	Emilia Romagna (Northern Italy)	13
3	53	Female	Veneto (Northern Italy)	28
4	53	Female	Toscana (Central Italy)	21
5	43	Female	Emilia Romagna (Northern Italy)	14

As reported on the background questionnaire, all native Italian-speaking participants heard and used only Italian between the ages of 0 and 5. Two of the five native speakers of Italian had studied Italian phonetics and phonology as part of undergraduate or postgraduate work. In addition to English and Italian, all native Italian-speaking participants speak French, while others also speak German and Spanish. Additionally, the participant from the Veneto region speaks Venetian dialect, while the participant from Tuscany speaks Tuscan dialect.

4.3 Materials

The present study examines L2 acquisition of the voiced stop consonants because these sounds are associated with different types of contrasts in each target language (TL) under investigation, as they are associated with the allophonic alternation between voiced stops and approximants in Spanish and with the phonemic contrast between voiced singleton and geminate stops in Italian. Given the regional variation in the distribution of Spanish voiced stops and approximants, the current study examines learners' acquisition of Spanish voiced stops in absolute utterance-initial position and their approximant allophones in intervocalic position because of the lack of variation in these contexts (Alvord & Christiansen, 2012; Shively, 2008). Similarly, this study investigates learners' acquisition of Italian voiced singleton and geminate stops in intervocalic position because geminate consonants most commonly appear in this context (Bertinetto & Loporcaro, 2005; Dmitrieva, 2012).

The same words containing the target sounds were used for the perception and production tasks in each TL. The word lists in each TL were randomized by item so that participants did not hear and produce target sounds at the same place of articulation repeatedly with no intervening words containing different sounds from those under investigation. Nonce Spanish and Italian words rather than real words were used to avoid potential differences in production and/or perception due to learners' familiarity with certain words and unfamiliarity with others. All target nonce words in Spanish and Italian were bisyllabic and were created based on real words to respect the phonotactics of each language. Additional nonce words in Spanish (e.g., *treto*) and Italian (e.g., *lova*) that contained sounds other than /b d g/ in absolute utterance-initial and intervocalic positions were also included to distract learners' attention from the target sounds under investigation, which could have influenced their production and/or perception. Target Spanish nonce words contained a voiced stop in absolute utterance-initial position and its corresponding approximant allophone in intervocalic position (e.g., *bobe* [ˈboβe]). Ten of each of the following voiced stop/approximant pairs: [b]-[β], [d]-[ð], and [g]-[γ] for a total of 30 sound pairs were analyzed per L2 Spanish learner and native speaker, meaning that 60 sounds were analyzed per participant. However, some L2 Spanish learners' and native speakers' productions of voiced stops were excluded because they lacked a burst, which made it difficult to measure prevoicing and voicing lag, if it was present.

Ten of each of the following voiced singleton/geminate stop pairs: /b/-/b:/, /d/-/d:/, and /g/-/g:/ for a total of 30 sound pairs were analyzed per L2 Italian learner and native speaker, meaning that 60 sounds were analyzed per participant. All target Italian

sounds appeared in intervocalic position, as in the following example: *nibo* /ˈnibo/ vs. *nibbo* /ˈnib:o/. However, some L2 Italian learners' productions of target singleton and geminate stops were excluded due to mispronunciations such as a third-year learner's production of *sigio* for the target word *sigo* in which she produced the target stop as an affricate. The word lists that were used for the Spanish and Italian production and perception tasks described in the following section are included as appendices 5 and 6, respectively.

4.4 Tasks

In order to investigate acquisition of allophonic and phonemic contrasts by L2 Spanish and Italian learners, participants first performed a perception task followed by a production task in their respective L2. Following the methodology employed in Kissling's (2013a) study on L2 acquisition of Spanish voiced approximants, the perception task consisted of a discrimination test and an identification test. Learners' production of the sounds associated with the target contrast in their respective L2 was assessed with a word list reading, similar to the production task Kissling used. A word list reading rather than a passage reading or a task designed to elicit spontaneous speech was used to ensure that learners at all instruction levels would be able to successfully complete the production task and to ensure that a sufficient number of tokens of target sounds in each language would be elicited. Since students enrolled in the first-year, second-semester course were not yet accustomed to reading paragraph-length discourse

in their L2, it is possible that they would have been cognitively overburdened by the demands of such a reading task.

Learners first completed the discrimination test followed by the identification test, which constituted the perception task, and they completed the production task last.[48, 49] For the perception task, learners heard nonce words containing target sounds in their respective L2 twice produced by a native speaker. The native Spanish and Italian speakers that recorded the stimuli used for the perception tasks in each TL were faculty at the same university the learners were attending, but were not included in the control groups of native speakers. Visual inspection of waveforms and spectrograms of both native speakers' productions ensured that each speaker did indeed distinguish between the target sounds under investigation in each language (i.e., voiced stops and approximants in Spanish and voiced singleton and geminate stops in Italian). For the Spanish discrimination test, participants were told that each word contained two tokens of the same consonant (e.g., two tokens of [b]) and they were to indicate on an answer sheet whether the two instances of the repeated consonant in each word were pronounced the same or differently. For the Spanish identification test, participants were instructed to write each word in standard Spanish orthography. For the Italian discrimination test, participants were instructed to indicate on an answer sheet whether they thought the speaker produced the same word twice or two different words. For the Italian identification test, if participants perceived the words in a pair to be different, they wrote

[48] Learners did not see the words written when they completed the discrimination and identification tests so that orthography would not have affected their perception of target sounds.
[49] Learners first completed the perception task followed by the production task because since the same word lists were used for both tasks, if they had completed the reading task first, it is likely that their perception would have been influenced by having previously seen the words written.

the words in the pair in standard Italian orthography. Finally, learners read the word list in their respective L2 out loud two times, while being audio-recorded.[50] To ensure high-quality recordings needed for acoustic analysis of speech, a Marantz professional solid state recorder PMD660 and head-mounted microphone were used. A control group of native Spanish and Italian speakers performed the same tasks in the same order as each group of L2 learners. No participants, learners or native speakers, were informed of the purpose of the study.

4.5 Data Analysis

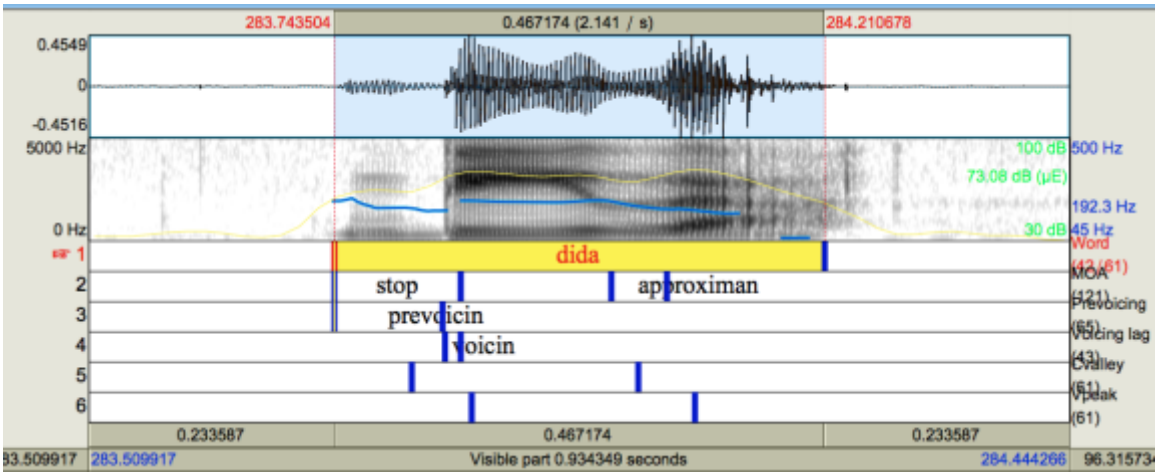
4.5.1 Spanish Production Data Analysis

Participants' productions were analyzed acoustically using Praat v.5.4.15 (Boersma & Weenik, 2015) signal-processing software. Voice onset time (VOT) of word-initial Spanish voiced stops was measured in Praat since it is one of the primary acoustic cues that distinguishes voiced stops from voiceless stops, word-initially. Following Lisker and Abramson's (1964) classic study, González-Bueno (1994), and Zampini (1998), VOT was measured in milliseconds (ms) as the interval between the release of the closure and the beginning of voicing. Since the vocal cords start vibrating before the release burst during the production of voiced stops in Spanish, the duration of this prevoicing or voicing lead was reported as a negative value. Although not widely reported, it is possible and has been shown empirically that voiced stops in L1 Spanish are produced with both voicing lead and voicing lag (cf. Deuchar & Clark, 1996).

[50] Only the data from the first repetition were analyzed because there were not differences in learners' production between the two word-list readings.

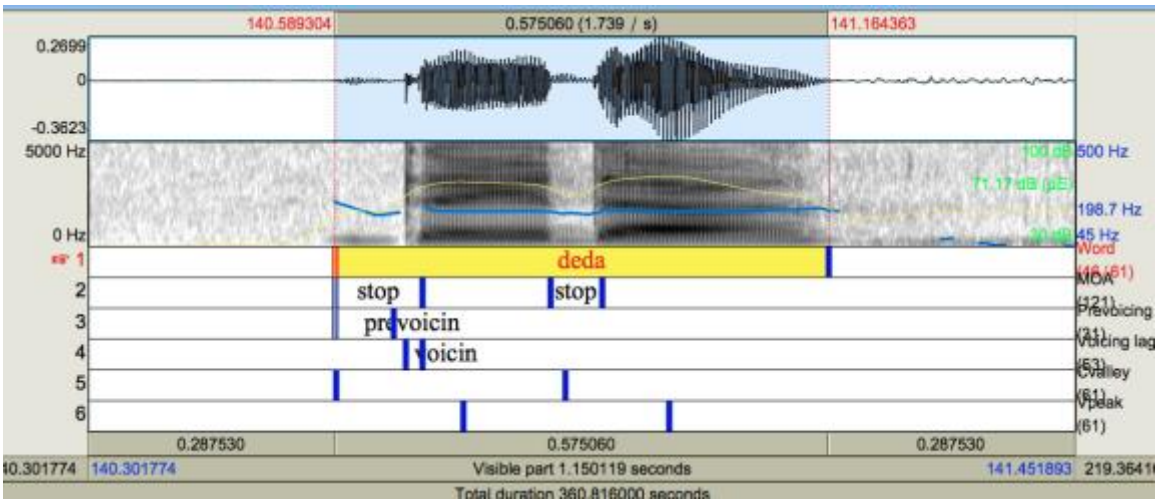
Therefore, voicing lag was also measured in those tokens in which it was present as the duration in ms between the burst and the onset of voicing in the following vowel, and reported as a positive value. In addition, in order to determine the degree to which L2 Spanish learners and native speakers distinguish between word-initial voiced stops and intervocalic voiced approximants, the intensity difference between each target consonant and the following vowel was measured using the intensity curve in Praat by subtracting the valley of the consonant from the peak of the following vowel. Figures 2 and 3 illustrate how target Spanish word-initial voiced stops were labeled.

Figure 2: Example of how production of target Spanish sounds was labeled



As shown in Figure 2, which shows a native Spanish speaker's production of the nonce word *dida*, prevoicing of target Spanish word-initial voiced stops was labeled in tier 3 and voicing lag, when present, was labeled in tier 4. The valley of both target consonants within each word was marked in tier 5, while the peak of the following vowel was marked in tier 6. Figure 3 is an example of a first-year L2 Spanish learner's production of the nonce word *deda* in which the word-initial [d] was produced with both prevoicing and voicing lag.

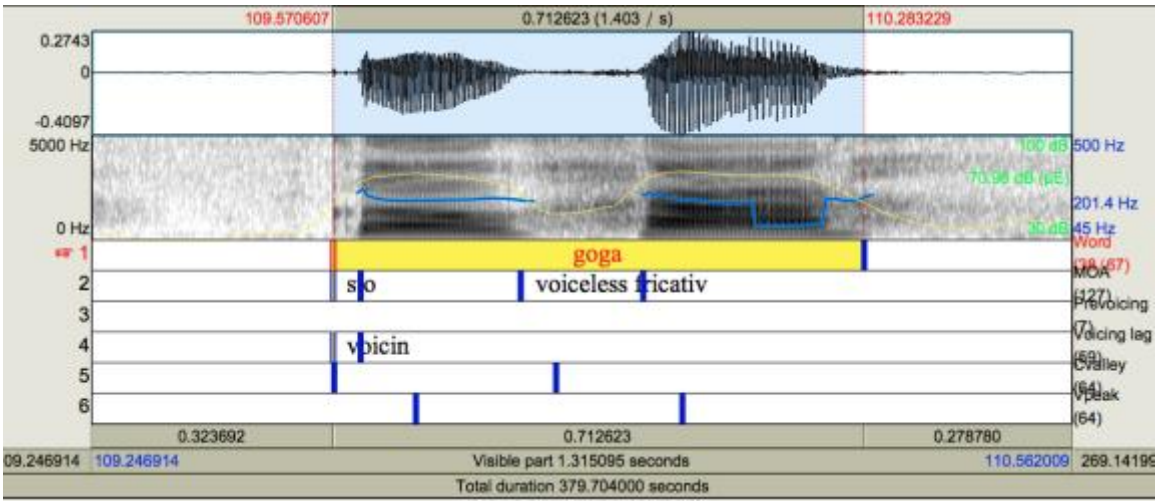
Figure 3: First-year L2 Spanish learner's production of prevoicing and voicing lag



Tokens of target approximants were also coded according to visual inspection of the spectrogram and waveform. Specifically, target approximants were coded for manner of articulation. Although all target approximants appeared in intervocalic position, a context in which these sounds are consistently realized as approximants across Spanish dialects, there was variation in L2 learners', and to a much lesser degree native speakers', production of these sounds, as they were produced as stops, approximants, and voiceless fricatives. Following Alvord and Christiansen (2012), tokens of target approximants were coded as target-like if they "exhibited the continuation of formant structure throughout the production of the consonant accompanied by a reduction in intensity" (p. 249). Tokens of target approximants were coded as stops and hence non-target-like if they exhibited a closure evidenced by a lack of energy followed by a release burst. Tokens of target approximants were coded as fricatives and hence non-target-like if they lacked a visible closure and had a portion of glottal frication in the waveform and spectrogram. Figure 2 above shows a native speaker's target-like production of an approximant, while

Figure 3 shows a first-year learner's production of a stop for a target approximant and Figure 4 shows a first-year learner's production of a voiceless fricative for a target approximant. The frequency of the different productions for target approximants, described above, between L1 and L2 speakers is presented in Chapter 5 along with the other results for the Spanish and Italian data.

Figure 4: First-year L2 Spanish learner's production of a voiceless fricative for a target approximant



Moreover, following Martínez Celdrán's (1991) finding that there are different degrees of approximants, as some are more open or closed than others, the degree of oral constriction of target approximants was measured using the intensity curve in Praat.[51] Most previous L2 acquisition studies on the Spanish stop/spirant alternation have analyzed learners' production from a binary perspective, reporting whether their production of approximants is target-like (Alvord & Christiansen, 2012; Castino, 1996; Díaz-Campos, 2004, 2006; Elliott, 1997; Face & Menke, 2009; González-Bueno, 1995;

[51] Intensity differences correlate with constriction, but they are not a direct measure of constriction.

González-Bueno & Quintana-Lara, 2011; Kissling, 2013a; Lord, 2005, 2010; Shively, 2008; Stevens, 2000; Zampini, 1994), while Rogers and Alvord (2014) is the only previous study, to the best of my knowledge, to examine the degree to which L2 learners spirantize intervocalic /b d g/, measuring the intensity difference between the valley of the consonant and the peak of the following vowel. Following Rogers and Alvord (2014), "the difference in decibels (dB) between these two measurements was considered the degree of oral constriction achieved by each speaker in each specific instance measured" (p. 409). The greater the intensity difference between these two measurements, the less spirantization achieved by the speaker on a given token; conversely, the smaller the intensity difference, the greater degree of spirantization achieved by the speaker on a given token (Eddington, 2011; Martínez Celdrán & Regueira, 2008; Rogers & Alvord, 2014). For example, a native Spanish speaker's production of the target approximant in the nonce word *gogua* showed a high degree of spirantization with an intensity difference of 3.86 dB, while a first-year learner's production of the target approximant in the nonce word *dida* showed less spirantization with an intensity difference of 13.01 dB.

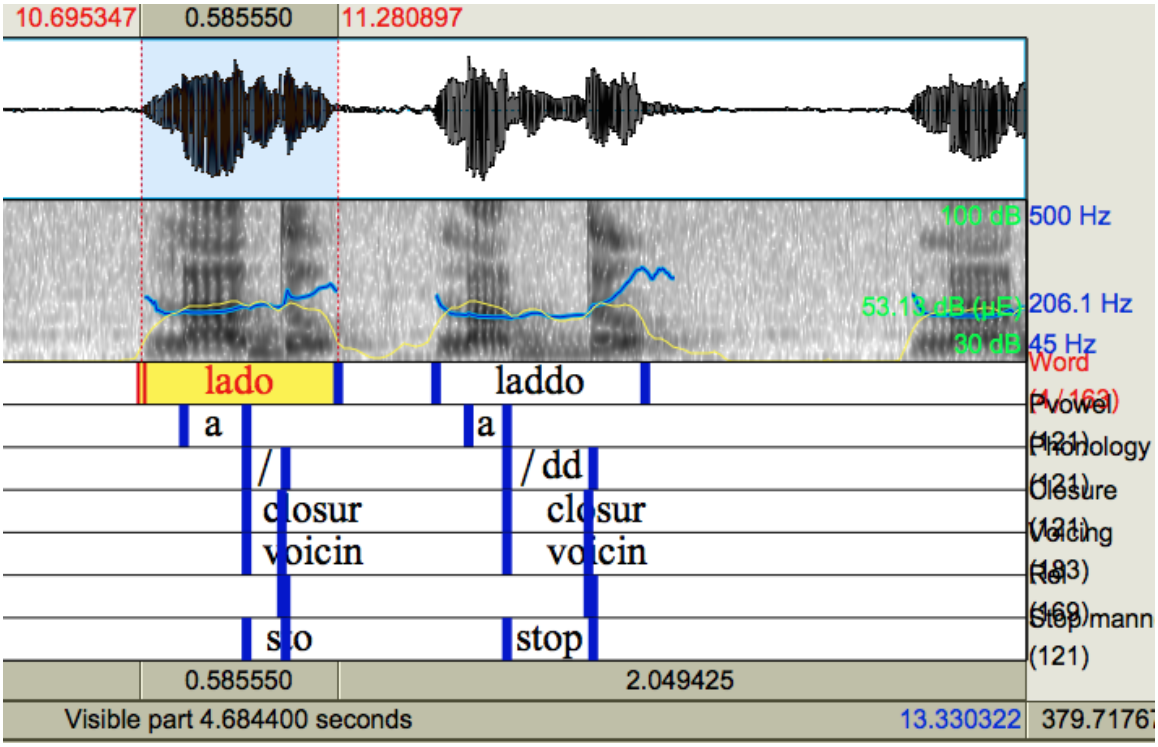
4.5.2 Italian Production Data Analysis

Acoustic analysis was also performed on the Italian production data using Praat and the same measurements, in ms, were made for both singleton and geminate stops following the methodology employed in Stevens' (2012) study on syntactic gemination (*raddoppiamento sintattico*) in Sienese Italian and in previous studies on the Italian singleton/geminate stop contrast (e.g., Pickett et al., 1999). First, the duration of the

vowel preceding the consonant was measured from the onset to the offset of periodicity of the vowel, as shown in tier 2 in Figure 5. The onset of the vowel was determined by regular formant activity and the offset was identified as the beginning of the consonant closure (Pickett et al., 1999). The overall duration of each stop consonant was then measured from the offset of the preceding vowel to the onset of the following vowel, as shown in tier 3 in Figure 5. In addition to the overall duration of each stop consonant, the component parts of closure and release were also measured, as shown in tiers 4 and 6, respectively, in Figure 5. Closure duration was measured from the offset of the preceding vowel to the onset of the burst, while the release was measured from the onset of the burst to the onset of the following vowel. The final measurement that was made was the C/V ratio, which was calculated from the consonant duration and the duration of the preceding vowel because Pickett et al. (1999) found that it helps to distinguish singletons and geminates across different speakers and speaking rates. Specifically, Pickett et al. (1999) found that a "ratio value of 1.0 can categorize the two categories" (p. 145), suggesting that speakers are successfully differentiating geminates from singletons. Closure duration (Cerrato & Falcone, 1998; Esposito & Di Benedetto, 1999; Pickett et al., 1999; Rosenzweig, 1965; Stevens, 2012; Vogel, 1982), preceding vowel duration (Esposito & Di Benedetto, 1999; Fava & Magno Caldognetto, 1976; Josselyn, 1900; Parmenter & Carman, 1932; Pickett et al., 1999; Stevens, 2012; Vogel, 1982), and the C/V ratio (Pickett et al., 1999) in particular were examined for the Italian production data because, as previously mentioned, studies have found that these phonetic cues are relevant to distinguishing Italian singleton stops and their corresponding geminate

counterparts. Figure 5 below is an example of how a native Italian speaker's production of the singleton and geminate stops in the target word pair *lado/laddo* was labeled.

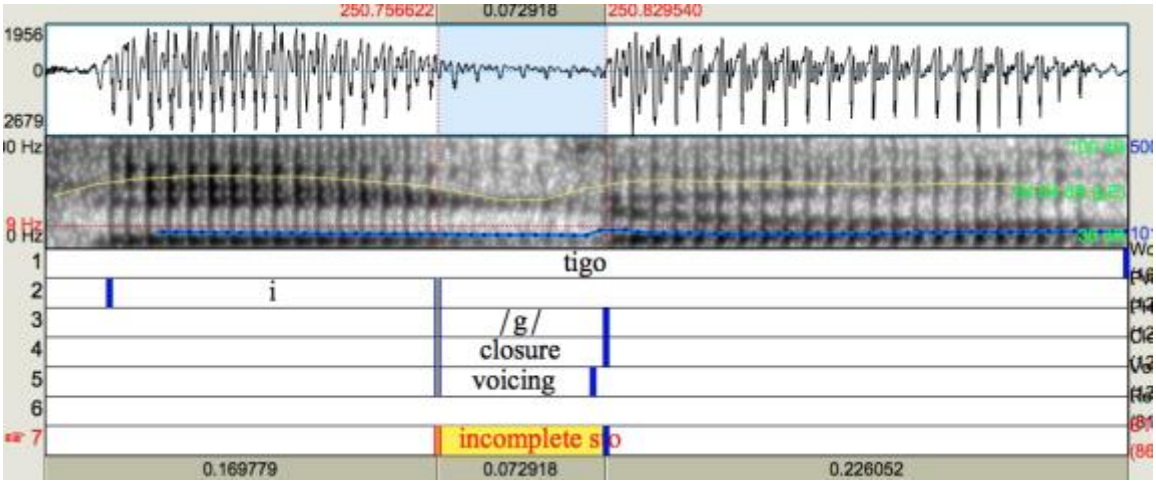
Figure 5: Example of how production of target Italian sounds was labeled



In addition, similar to the variation in the manner of articulation of target voiced approximants in Spanish produced by L2 learners, and to a much lesser degree native speakers, there was variation in the manner of articulation of target voiced singleton and geminate stops in Italian produced by both L2 learners and native speakers. There was more variation in production of target singleton stops, and as expected, in L2 learners' speech. The frequency of the different productions for /b d g/ and /b: d: g:/, described below, between L1 and L2 speakers is presented in Chapter 5 along with the other results for the Spanish and Italian data. Tokens of target voiced singleton and geminate stops were produced correctly as complete stops, but incorrectly as incomplete stops, voiced

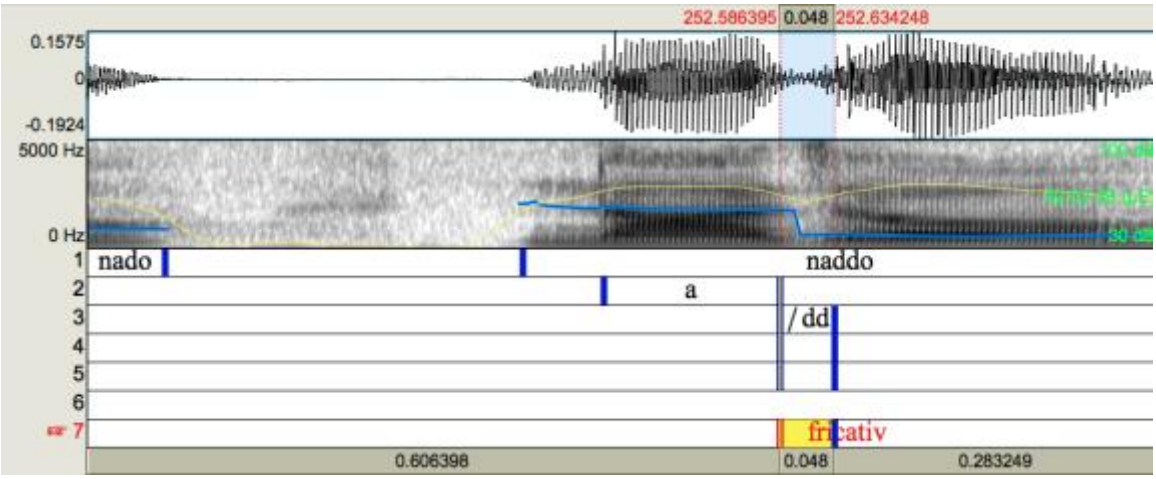
approximants, and voiced fricatives. A complete stop was coded as a production that exhibits a closure and a visible release burst, as shown in a native speaker's production of target /d/ and /d:/ in Figure 5 above. An incomplete stop was coded as a production that does not have a visible release burst, indicating an incomplete closure, as shown in a first-year L2 Italian learner's production in Figure 6.

Figure 6: First-year L2 Italian learner's production of an incomplete stop for a target voiced singleton stop



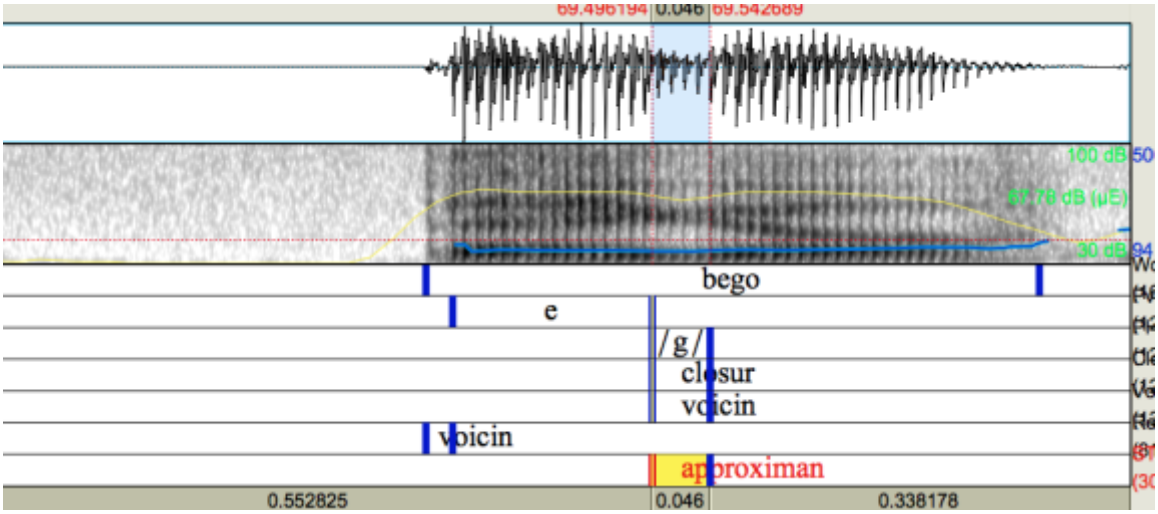
A fricative was coded as a production that lacks a visible closure and has a portion of glottal frication in the waveform and spectrogram, as shown in a first-year L2 Italian learner's production in Figure 7.

Figure 7: First-year L2 Italian learner's production of a voiced fricative for a target voiced geminate stop



Finally, an approximant was coded as a production that exhibits the continuation of formants from the preceding vowel throughout the production of the consonant and a decrease in intensity, as shown in a first-year L2 Italian learner's production in Figure 8.

Figure 8: First-year L2 Italian learner's production of a voiced approximant for a target voiced singleton stop.



4.5.3 Perception Data Analysis

The Spanish and Italian perception data were analyzed following the methods employed in Kissling (2013a). Correct responses on the discrimination test in both Spanish and Italian were assigned 1 point (i.e., the participant chose "different") and incorrect responses were assigned 0 points (i.e., the participant chose "same"). Each group of participants' points were added to determine their accuracy in discriminating between target sounds. For the identification test, participants' spelling of words containing target sounds was assigned a score of 1, .5, or 0. The frequency of these three possible scores, described below, is presented in Chapter 5 as well as the other results for the Spanish and Italian data. Since the written representation of Spanish voiced stops and approximants is the same, points were assigned according to the method employed in Kissling (2013a):

> 1 point was assigned to spellings that are non-standard yet indicate that the learner had likely perceived the target sound correctly (e.g., "b" and "v" were accepted for [β], "d" and "th" for [ð], and "g" or "gu" before "e" or "i" for [γ]). (p. 93)

Conversely, since the written representation of Italian singleton stops (single letter) and geminate stops (double letter) is different, it was not necessary to accept non-standard spellings for target sounds likely perceived correctly.

A participant's response on the identification test was assigned 1 point if it was completely correct, i.e., he/she identified the difference between the target sounds in his/her L2 rather than a difference between one of the target sounds and a different sound in his/her L2. For example, a first-year L2 Spanish learner received 1 point for his correct

spelling of the target word *dadu.* Similarly, a first-year L2 Italian learner received 1 point for his correct spelling of the target word pair *lude*/*ludde*. A participant's response on the identification test was assigned .5 point if it was partially correct, i.e., he/she identified a difference other than the target one between the word-initial and intervocalic consonants in Spanish or between the intervocalic stops in Italian. For example, a third-year L2 Spanish learner received .5 point for his response of *bugu* for the target word *bubu* because he identified a difference between the word-initial and intervocalic consonants, but not the target one, as this spelling indicates the learner heard a difference between [b] and [g] rather than between two different pronunciations of [b]. Similarly, a third-year L2 Italian learner received .5 point for his response of *dico*/*dicco* for the target word pair *tigo*/*tiggo* because he identified a length difference between the two intervocalic consonants, but not between the correct target sounds, as he identified a length difference between the voiceless singleton and geminate stops /k/-/k:/ rather than between the voiced singleton and geminate stops /g/-/g:/. Finally, a participant's response on the identification test was assigned 0 points if it was completely incorrect, i.e., his/her response indicated that he/she did not perceive the difference between the target sounds in his/her L2. For example, a fourth-year L2 Spanish learner's response of *tuzu* for the target word *dudu* received 0 points because it did not include the written representation of at least one of the target sounds, indicating that she heard entirely different consonants in word-initial and intervocalic positions in this word. A fourth-year L2 Italian learner's response of *lado*/*lato* for the target word pair *lado*/*laddo* received 0 points because it indicated that she did not identify the target length contrast between the two intervocalic

consonants. In addition, responses on the Italian identification test that only included the spelling of one of the words in the pair (e.g., a response of *lida* for the target word pair *lida*/*lidda*) also received 0 points because they did not indicate that the participant perceived the length contrast between the target intervocalic consonants. Once the data from the identification test were coded, each group of participants' points were added to determine their accuracy in identifying the target difference between sounds in their respective L2.

4.5.4 Statistical Analysis

In addition to the acoustic analysis of the production data and the analysis of the perception data, statistical analysis was performed on the production and perception data using SPSS (Statistical Package for the Social Sciences, 2013). Descriptive statistics for the relevant phonetic cues of target sounds produced by L2 learners and native speakers of each language were obtained. Specifically, descriptive statistics for the following measurements were obtained for the Spanish production data: prevoicing and voicing lag in ms as well as consonant valley, following vowel peak, and intensity difference between the consonant valley and following vowel peak in dB, while descriptive statistics for the following measurements made in ms were obtained for the Italian production data: preceding vowel duration, overall stop duration, closure duration, and C/V ratio. Mean accuracy percentages were also obtained for each group of participants' points on the discrimination and identification tests in each language.

The four research questions that guided the study, presented in Chapter 1 and

restated below, determined how the data were analyzed and the appropriate statistical tests to perform in order to examine whether there were significant differences between L2 learners' and native speakers' production and perception of target sounds in each language.

1. Are L2 learners more accurate in producing or perceiving the sounds associated with allophonic and phonemic contrasts in their respective L2? In other words, are L2 Spanish learners more accurate in producing or perceiving voiced stops and approximants? Are L2 Italian learners more accurate in producing or perceiving Italian voiced singleton and geminate stops?

2. How do learners at different instruction levels produce and perceive the sounds associated with allophonic and phonemic contrasts in their respective L2? Is there development between levels?

3. Are learners' productive and perceptive abilities related?

4. Do L2 learners (L1 American English) better perceive the allophonic alternation between Spanish voiced stops and approximants or the phonemic contrast between Italian voiced singleton and geminate stops?

To answer the first research question comparing production and perception accuracy in each TL, separate accuracy scores for the Spanish and Italian production data were calculated and compared to the respective accuracy scores for the Spanish and Italian perception data. First, the native speaker range - determined by the minimum and maximum values listed in the descriptive statistics - by sound, on each measure, was obtained and used as a baseline against which to compare the learner data. Learner

productions that were within the native speaker range on a given measure were assigned 1 point, while learner productions that were not within this range were assigned 0 points. First, the accuracy score for each subcomponent measure in each language was calculated per learner level (i.e., Spanish: prevoicing, voicing lag, and intensity difference for word-initial [b d g] and intensity difference for intervocalic [β ð γ]; Italian /b d g/ and /b: d: g:/: preceding vowel duration, overall stop duration, consonant closure duration, and C/V ratio).[52] Then the accuracy scores for each subcomponent measure in each language were averaged to obtain one overall production accuracy score per learner level per language.

Separate analyses of variance (ANOVA) were performed on the Spanish and Italian production data, with participant level (i.e., native speaker, first-year learner, third-year learner, fourth-year learner) as the independent variable and each phonetic measurement listed in the previous paragraph as the dependent variable to answer the second research question about development in learners' production of target sounds between instruction levels. Separate ANOVAs were also performed on the Spanish and Italian perception data, with participant level as the independent variable and mean discrimination accuracy and mean identification accuracy as the dependent variables to

[52] As explained earlier in this chapter, consonant valley and following vowel peak measurements were made for target Spanish word-initial voiced stops and intervocalic voiced approximants to calculate the mean intensity difference between target consonants and the following vowel. Since how small or large the intensity difference between the valley of the consonant and the peak of the following vowel is of greater interest than the actual peak and valley measurements, accuracy scores were not calculated for these two measures but rather just for the intensity difference for target [b d g] and [β ð γ]. In addition, descriptive statistics were not obtained for release duration of Italian /b d g/ and /b: d: g:/ and production accuracy scores were not calculated for this measure because it is not a main acoustic cue to the Italian singleton/geminate stop contrast. Descriptive statistics were only obtained for and production accuracy scores were only calculated for the main acoustic cues to the Italian singleton/geminate stop contrast, which are preceding vowel duration, overall stop duration, closure duration, and C/V ratio.

answer the second research question about development in learners' perception of target sounds between instruction levels. Post-hoc Tukey HSD tests were subsequently carried out to determine the nature of significant findings revealed by the ANOVAs. The level of significance was preset at 0.05 for all statistical analyses.

In order to determine whether L2 learners' production and perception of the sounds associated with the target contrast in their respective L2 are related, as asked in the third research question, correlation analyses were performed on subsets of the production and perception data with regard to the independent variable, participant level, in addition to the entire data set overall with all participants (native speakers and learners) grouped together. Since there are separate values for each acoustic cue (preceding vowel duration, overall stop duration, closure duration, and mean C/V ratio for geminates) associated with each speaker's production of singletons and corresponding geminates in Italian, the difference between singletons and geminates on each of the first three cues was calculated and in addition to the mean C/V ratio for geminates was correlated to discrimination and identification accuracy in separate analyses. For the Spanish data, only degree of oral constriction was correlated to discrimination and identification accuracy, in separate analyses, because the other measurements for voiced stops and approximants were different. Furthermore, since separate oral constriction measurements were made for the stops and approximants, the difference between stop oral constriction and approximant oral constriction was calculated and correlated to discrimination and identification accuracy. The level of significance was preset at 0.05 for all correlation analyses.

Finally, to answer the fourth research question whether L2 learners better perceive the Spanish allophonic or Italian phonemic contrast, learners' mean discrimination and mean identification accuracy were averaged across instruction levels to obtain their overall mean discrimination accuracy and overall mean identification accuracy per language. L2 Spanish learners' mean discrimination accuracy and mean identification accuracy were averaged across the three levels to obtain all Spanish learners' overall mean discrimination accuracy and overall mean identification accuracy. Likewise, L2 Italian learners' mean discrimination accuracy and mean identification accuracy were averaged across the three levels to obtain all Italian learners' overall mean discrimination accuracy and overall mean identification accuracy.

In the following chapter, the production and perception results are first presented separately followed by the results of the correlation analyses. The results chapter begins with a discussion of the Spanish production and perception results followed by a discussion of the results of the correlation analyses on the Spanish data. The Italian production and perception results are then reported separately followed by the results of the correlation analyses on the Italian data.

Chapter 5 Results

5.1 Introduction

The results of the present cross-linguistic study of second language (L2) learners' acquisition of the sounds associated with the target contrast in their respective L2 (i.e., the allophonic alternation between word-initial voiced stops [b d g] and intervocalic voiced approximants [β ð γ] in Spanish and the phonemic contrast between intervocalic voiced singleton stops /b d g/ and voiced geminate stops /b: d: g:/ in Italian) are presented in this chapter. The Spanish production and perception results are reported in Sections 5.2 and 5.3, respectively, while the results of the correlation analyses on the Spanish data are presented in Section 5.4. The Italian production and perception results are reported in Sections 5.5 and 5.6, respectively, while the results of the correlation analyses on the Italian data are presented in Section 5.7.

5.2 Spanish Production Results

The results of the acoustic analysis on Spanish word-initial voiced stops are presented first in this section. As stated in Chapter 4, the following measurements were made on all tokens of word-initial [b d g]: prevoicing (ms), voicing lag (ms), when present, consonant valley (dB), following vowel peak (dB), and the intensity difference between the consonant valley and the following vowel peak (dB). Following the acoustic analysis, descriptive statistics, mean and standard deviation, for each of these cues were obtained from SPSS and are reported by participant level (i.e., native speakers, first-year

learners, third-year learners, fourth-year learners) with all three target voiced stops grouped together in the following table.

Table 7: Descriptive statistics for Spanish word-initial [b d g], mean and standard deviation (in parentheses)

Participant level	Prevoicing (ms)	Voicing lag (ms)	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	-71.71 (35.00)	8.68 (12.55)	50.00 (7.22)	69.98 (8.22)	19.98 (5.44)
First-year learners	-16.86 (33.84)	21.42 (13.47)	55.73 (7.59)	69.67 (5.61)	13.94 (5.61)
Third-year learners	-19.45 (34.67)	20.65 (12.87)	54.34 (7.27)	69.11 (5.33)	14.77 (5.26)
Fourth-year learners	-36.99 (47.18)	15.56 (11.82)	57.65 (6.76)	73.12 (5.17)	15.47 (6.38)

As observed in Table 7, L2 Spanish learners do not produce Spanish word-initial voiced stops with a similar degree of prevoicing as native speakers; however, it is noteworthy that learners at all levels of instruction produce these sounds with some degree of voicing lead. It is particularly encouraging that even first-year learners produce word-initial [b d g] with prevoicing, as previous studies (González-Bueno, 1994; Zampini, 1998) have found that L2 Spanish learners, even at intermediate and advanced levels of instruction and many of whom received explicit pronunciation instruction, fail to produce these sounds with any amount of voicing lead. It is possible that the difference in prevoicing observed in the learners in the present study and those in González-Bueno (1994) is due to differences in the tasks used in each study, as González-Bueno (1994) relied on spontaneous speech data, while the data in the present study come from a word list reading, which may favor prevoicing due to hyperarticulation in laboratory speech.

Although Zampini (1998) similarly used a reading task to assess learners' production, she did not find prevoicing perhaps because her correlation data for [b] suggest that production and perception are independent processes. If learners do not perceive tokens produced with prevoicing as [b], it would not be unexpected that they would struggle to produce them with prevoicing.

Moreover, it is important to also consider the frequency with which learners in the present study produce word-initial voiced stops with prevoicing because not all tokens of the target sounds were produced with voicing lead. Native speakers expectedly produced [b d g] with prevoicing the most, as 110/119 tokens (92%) were prevoiced. In comparison, 41/174 tokens (24%) produced by first-year learners were prevoiced. Third-year learners produced [b d g] with prevoicing 28% of the time (75/270 tokens), while fourth-year learners produced [b d g] with prevoicing 44% of the time (104/238 tokens). Although learners in the present study produce word-initial voiced stops with prevoicing less than native speakers, the frequency with which they produce these sounds with prevoicing increases across the three instruction levels.

In addition to producing target word-initial [b d g] with prevoicing, both native speakers and learners produce these sounds with voicing lag, albeit to varying degrees.[53] Although learners at all levels of instruction produce word-initial [b d g] with more voicing lag, on average, than native speakers, the amount of voicing lag in learners'

[53] Although not widely reported, previous studies (Deuchar & Clark, 1996) have documented both voicing lead and voicing lag in L1 production of Spanish word-initial voiced stops. Deuchar and Clark (1996) reported that an L1 Spanish speaker produced [b d g] with mean lead voice onset times (VOTs) of -62 ms, -87 ms, and -88 ms, respectively, and mean lag VOTs of 9 ms, 15 ms, and 22 ms, respectively. They reported that another L1 Spanish speaker produced [b d g] with only voicing lag, with mean lag VOTs of 5 ms, 10 ms, and 5 ms, respectively.

productions decreases from the first- to the fourth-years of language study. Given L2 Spanish learners' well-documented difficulty in acquiring voiced stops, it is not unexpected that the L2 learners in the present study produce these sounds, on average, with less voicing lead but more voicing lag than native speakers. Finally, the intensity difference between the valley of the consonant and the peak of the following vowel is greatest in the native speakers' productions, indicating that they produce voiced stops, on average, with a higher degree of oral constriction than learners.

The descriptive statistics, mean and standard deviation, for each of the phonetic cues are also reported by each individual voiced stop for each group of participants in the following tables.

Table 8: Descriptive statistics for Spanish word-initial [b], mean and standard deviation (in parentheses), by participant level

Participant level	Prevoicing (ms)	Voicing lag (ms)	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	-74.80 (33.92)	.88 (3.31)	50.67 (9.18)	69.19 (8.43)	18.53 (5.36)
First-year learners	-14.71 (30.43)	16.13 (10.54)	57.06 (7.66)	70.34 (5.30)	13.28 (5.87)
Third-year learners	-20.64 (37.21)	14.27 (10.28)	55.35 (7.96)	69.01 (5.48)	13.66 (5.58)
Fourth-year learners	-36.37 (47.73)	9.94 (9.59)	58.67 (7.06)	73.22 (5.53)	14.55 (6.59)

Table 9: Descriptive statistics for Spanish word-initial [d], mean and standard deviation (in parentheses), by participant level

Participant level	Prevoicing (ms)	Voicing lag (ms)	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	-79.28 (31.12)	5.55 (8.08)	49.62 (5.98)	69.35 (7.90)	19.73 (5.17)
First-year learners	-20.70 (34.98)	20.42 (10.97)	54.98 (7.96)	69.17 (5.92)	14.19 (5.67)
Third-year learners	-21.92 (34.59)	19.09 (10.16)	54.95 (6.98)	68.93 (5.40)	13.98 (4.70)
Fourth-year learners	-39.53 (49.84)	14.54 (9.62)	57.96 (7.05)	72.74 (5.25)	14.78 (6.76)

Table 10: Descriptive statistics for Spanish word-initial [g], mean and standard deviation (in parentheses), by participant level

Participant level	Prevoicing (ms)	Voicing lag (ms)	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	-60.79 (37.92)	19.90 (14.39)	49.70 (6.14)	71.44 (8.34)	21.74 (5.42)
First-year learners	-14.97 (35.86)	27.37 (15.86)	55.26 (7.09)	69.55 (5.59)	14.30 (5.33)
Third-year learners	-15.79 (32.10)	28.60 (13.58)	52.73 (6.60)	69.40 (5.14)	16.66 (4.98)
Fourth-year learners	-35.05 (44.32)	22.08 (12.71)	56.35 (5.99)	73.41 (4.77)	17.06 (5.51)

As reported in Tables 8 through 10, participants produce the individual voiced stops with varying degrees of prevoicing, increasing across the three groups of learners. Although fourth-year learners produce [b d g] with the most voicing lead among the three learner groups, they are still quite short of the native speakers' mean voicing lead values. All participants produce [d] with the most prevoicing, while all participants except first-

year learners produce [g] with the least amount of prevoicing. In their classic study on voice onset time (VOT) in L1 Spanish, Lisker and Abramson (1964) found that among the voiced stops, [b] was produced with the most and [g] was produced with the least voicing lead.

All learners in the present study also produce each individual target sound with more lag voicing, on average, than native speakers. While learners' mean prevoicing values increase across instruction levels on each individual voiced stop, their mean lag voicing values generally decrease across instruction levels, with the exception of [g], which increases slightly from the first- to the third-year learners but then decreases from the third- to the fourth-year learners. Finally, the intensity difference between the valley of the consonant and the peak of the following vowel increases across participant groups and places of articulation such that native speakers, expectedly, achieve the highest degree of oral constriction and that the voiced stops produced further backwards in the vocal tract (e.g., [g]) are produced with the most oral constriction.

Having presented the results of the acoustic analysis on Spanish word-initial voiced stops, we will now turn our attention to the results of the acoustic analysis on Spanish intervocalic voiced approximants. As stated in Chapter 4, although all target approximants appeared in intervocalic position, a context in which these sounds are consistently realized as approximants across Spanish dialects, there was variation in L2 learners', and to a much lesser degree native speakers', production of these sounds, as they were produced as stops, approximants, and voiceless fricatives. The frequency of these different productions for target approximants between L1 and L2 speakers is

presented in Table 11 below. In addition, the descriptive statistics, mean and standard deviation, for each of the following measurements made on all tokens of intervocalic [β ð γ]: consonant valley (dB), following vowel peak (dB), and the intensity difference between the consonant valley and the following vowel peak (dB) are reported in this section. The descriptive statistics for these cues are reported first by participant level with all three target voiced approximants grouped together and then by participant level and each individual sound.

Table 11: Frequency of different productions for target approximants

Participant level	Manner of articulation
Native speakers	Approximant: 103/119; 87%
	Stop: 16/119; 13%
	Voiceless fricative: 0/119; 0%
First-year learners	Approximant: 40/174; 23%
	Stop:126/174; 72%
	Voiceless fricative: 8/174; 5%
Third-year learners	Approximant: 73/270; 27%
	Stop: 196/270; 73%
	Voiceless fricative: 1/270; 0%
Fourth-year learners	Approximant: 98/238; 41%
	Stop: 140/238; 59%
	Voiceless fricative: 0/238; 0%

As observed in Table 11, there was more variation in L2 learners' production of target approximants than in native speakers' productions. Native speakers produced target approximants as such 87% of the time, while they produced target approximants as stops 13% of the time. Only 23% of first-year learners' productions were approximants, while 72% were stops and 5% were voiceless fricatives. There was a slight increase in approximant and stop productions in the third-year learners, who produced approximants 27% of the time and stops 73% of the time, respectively; while only one third-year

learner produced a target approximant as a voiceless fricative. Finally, there was a larger increase in approximant productions in the fourth-year learners, who produced approximants 41% of the time, and a decrease in stop productions, which accounted for 59% of all fourth-year learner productions.

Learners' overall accuracy for target approximants, while low, is comparable to or higher than the results of previous studies that have examined L2 acquisition of Spanish voiced approximants by similar groups of learners. Zampini (1994) investigated the effect of speech style on L2 acquisition of Spanish voiced approximants by learners enrolled in a second-semester intensive course and in a fourth-semester intensive course, finding that neither group's accuracy approached 50%, as the highest percentage achieved was 32.03% for [β] by fourth-semester students on a conversational task, which is slightly higher than third-year learners' overall accuracy. Díaz-Campos (2004) investigated the effect of context of learning in a group of at-home (AH) learners and in a group of study abroad (SA) learners, both of whom averaged an intermediate-low proficiency level according to the results of an OPI, finding that overall only 13% of learners' productions of voiced approximants were target-like, while 87% were non-target-like. Even first-year learners in the present study outperformed learners in Díaz-Campos (2004), accurately producing voiced approximants 23% of the time. Moreover, all three groups of learners in the present study outperformed the SA learners in Díaz-Campos (2006) who accurately produced voiced approximants just 11% of the time, while fourth-year learners in the present study outperformed the AH learners in Díaz-Campos (2006) who produced voiced approximants 37% of the time.

First-year learners in the present study, who were enrolled in a second-semester Spanish course, outperformed the second-semester students in Shively's (2008) study who accurately produced voiced approximants 13% of the time on a passage reading and 7% of the time on a word list reading. Students enrolled in an upper-division Spanish phonetics course also participated in Shively's study, accurately producing target sounds 42% of the time on the word list reading, which is slightly higher than fourth-year students' accuracy who were not enrolled in such a course. The third-year learners' mean accuracy in the present study is comparable to fourth-semester learners' mean accuracy in Face and Menke's (2009) study who accurately produced voiced approximants 35.66% of the time. It is also interesting to compare the results of the present study to Lord's (2010) results in a study on the combined effect of explicit instruction and immersion in a target language (TL) community on L2 acquisition of Spanish voiced approximants by learners in their third- or fourth-year of Spanish study. Lord found that learners who did not receive pronunciation instruction prior to their SA increased their accuracy on the three allophones from 3.3% on the pretest to 5.8% on the posttest, while learners who did receive such instruction prior to their SA increased their accuracy from 8.6% to 28.7%. All learners in the present study outperformed the learners in Lord's study that did not receive pronunciation instruction prior to their SA on both the pretest and the posttest, while the learners in Lord's study that received pronunciation instruction prior to their SA slightly outperformed the first- and third-year learners in the present study only on their posttest, but did not outperform fourth-year learners in the present study on either their pretest or posttest.

In summary, the results of the present study and previous studies discussed above and in Chapter 2 attest the difficulty with which L2 Spanish learners, even at advanced levels of instruction in the university curriculum, acquire voiced approximants. Other previous studies have found that only L2 learners at very advanced levels of proficiency, such as graduating Spanish majors and Ph.D. students (Face & Menke, 2009) or learners who have spent an extended time abroad in a Spanish-speaking country (Alvord & Christiansen, 2012) produce voiced approximants with 60% accuracy or greater.

Having reported the variation in the manner of articulation of target approximants between native speakers and the three groups of L2 learners in the present study, we will now turn our attention to the descriptive statistics for each of the three aforementioned measurements made on all tokens of intervocalic [β ð γ]: consonant valley (dB), following vowel peak (dB), and the intensity difference between the consonant valley and the following vowel peak (dB).[54] The descriptive statistics, mean and standard deviation, for these cues are reported first in Table 12 by participant level with all three target voiced approximants grouped together and then in Tables 13 through 15 by participant level and each individual sound.

[54] The mean consonant valley and following vowel peak measurements and standard deviations are included in Tables 12-15 to show how the mean intensity difference was calculated per participant level, but are not discussed separately. How small or large the intensity difference between the valley of the consonant and the peak of the following vowel is of greater interest than the actual peak and valley measurements. It is likely for this reason that Rogers and Alvord (2014), the only previous study to examine the degree of spirantization in L2 Spanish, only reported participants' mean intensity difference.

Table 12: Descriptive statistics for Spanish intervocalic [β ð ɣ], mean and standard deviation (in parentheses)

Participant level	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	54.65 (8.38)	65.92 (8.42)	11.26 (4.39)
First-year learners	53.93 (6.43)	67.65 (6.89)	13.72 (5.96)
Third-year learners	53.87 (7.34)	68.74 (5.41)	14.87 (6.40)
Fourth-year learners	58.43 (6.44)	71.23 (5.48)	12.80 (5.69)

Among all study participants, native speakers expectedly spirantized intervocalic /b d g/ the most, as indicated by their lowest mean intensity difference. Although first-, third-, and fourth-year learners achieved less spirantization than native speakers, their mean intensity differences (13.72 dB, 14.87 dB, and 12.80 dB, respectively) were not considerably greater than the native speakers' mean intensity difference of 11.26 dB. Rogers and Alvord (2014), the only previous study to the best of my knowledge to examine the degree to which L2 Spanish learners spirantize intervocalic /b d g/, found higher levels of spirantization in their native speaker participants and learners who had spent an extended time abroad. Native speakers in Rogers and Alvord's (2014) study had a mean intensity difference of 3.86 dB, while learners who spent two years abroad in a Spanish-speaking country as religious missionaries had a mean intensity difference of 6.24 dB and at-home learners who had studied four semesters of university Spanish had a mean intensity difference of 13.53 dB. It is not surprising that the abroad learners in Rogers and Alvord (2014) achieved a greater degree of spirantization than the learners in the present study, as it has previously been reported that learners who spent an extended time in a Spanish-speaking country are among the few groups of L2 learners to have any

success in acquiring Spanish voiced approximants (Alvord & Christiansen, 2012). In addition, it is noteworthy that the mean intensity differences of learners in the present study are comparable to the mean intensity difference of the at-home learners in Rogers and Alvord (2014). It is particularly noteworthy that the first-year learners in the present study, who were enrolled in a second-semester Spanish course, produced intervocalic /b d g/ with a very similar degree of spirantization as the at-home learners in Rogers and Alvord (2014) who had completed four semesters of Spanish.

Table 13: Descriptive statistics for Spanish intervocalic [β], mean and standard deviation (in parentheses)

Participant level	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	53.70 (8.48)	65.32 (8.13)	11.62 (3.64)
First-year learners	53.87 (5.87)	69.26 (6.42)	15.39 (5.11)
Third-year learners	53.67 (6.85)	69.26 (5.24)	15.58 (5.76)
Fourth-year learners	58.95 (6.94)	71.28 (5.35)	12.33 (6.09)

Table 14: Descriptive statistics for Spanish intervocalic [ð], mean and standard deviation (in parentheses)

Participant level	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	55.49 (6.57)	65.45 (7.31)	9.96 (4.12)
First-year learners	56.17 (7.05)	65.95 (7.51)	9.78 (3.88)
Third-year learners	55.77 (7.83)	67.78 (5.43)	12.02 (5.86)
Fourth-year learners	59.60 (6.44)	70.34 (5.40)	10.74 (4.41)

Table 15: Descriptive statistics for Spanish intervocalic [γ], mean and standard deviation (in parentheses)

Participant level	Consonant valley (dB)	Following vowel peak (dB)	Intensity difference (dB)
Native speakers	54.77 (9.91)	67.01 (9.79)	12.24 (5.09)
First-year learners	51.70 (5.51)	67.88 (6.34)	16.18 (6.44)
Third-year learners	52.16 (6.94)	69.17 (5.48)	17.02 (6.54)
Fourth-year learners	56.76 (5.62)	72.08 (5.60)	15.32 (5.53)

All participants, native speakers and all groups of L2 learners, in the present study produced [ð] with the most spirantization followed by [β] and [γ]. Although there were not large differences in the degree of spirantization achieved by native speakers and abroad learners on individual sounds in Rogers and Alvord's (2014) study, they also produced [ð] with the most spirantization followed by [β] and [γ]. At-home learners in Rogers and Alvord (2014) produced [β] with the most spirantization followed by [ð] and [γ]. It is not surprising that all participants in both studies produced [γ] with the least amount of spirantization, as approximants produced further backwards in the vocal tract (e.g., velars) are more constricted than approximants produced further forward in the vocal tract (e.g., bilabials and dentals). Having presented the results of the acoustic analysis on Spanish word-initial voiced stops and intervocalic voiced approximants, the results of the Spanish perception task are reported in the following section.

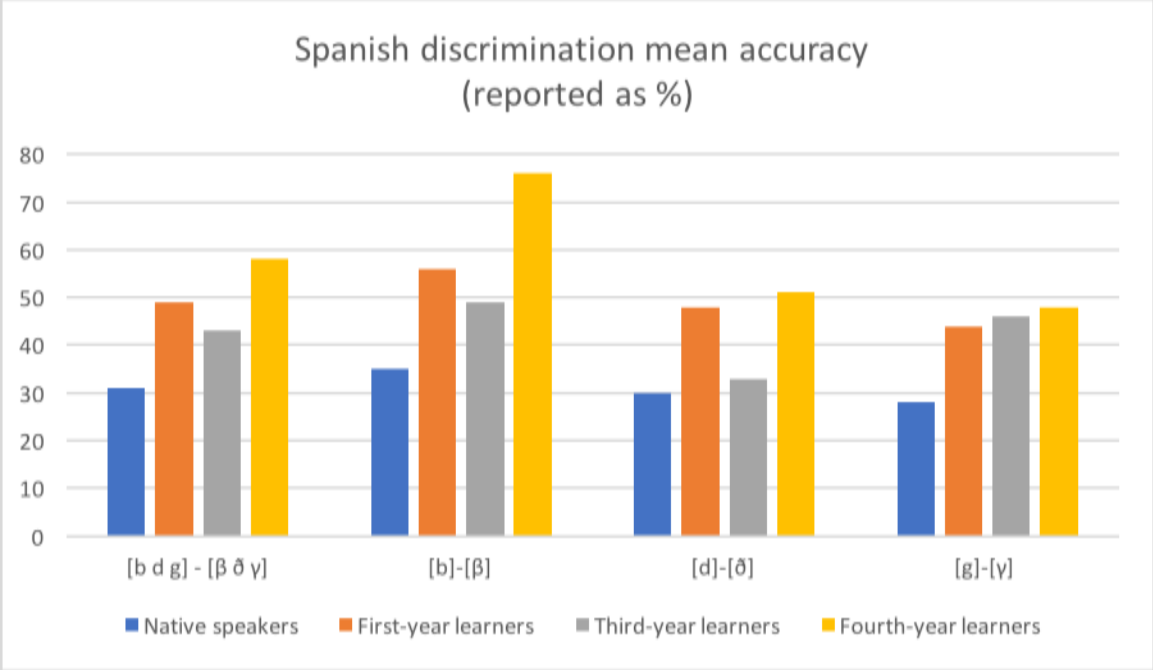
5.3 Spanish Perception Results

The results of the discrimination and identification tests, which comprised the Spanish perception task, are reported in this section. As explained in Chapter 4, correct

responses on the discrimination test were assigned 1 point (i.e., the participant chose "different") and incorrect responses were assigned 0 points (i.e., the participant chose "same"), while participants' responses on the identification test were assigned a score of 1, .5, or 0.[55] After all participant responses were coded, descriptive statistics, mean accuracy and standard deviation, were obtained from SPSS. The descriptive statistics for the discrimination and identification data are reported by participant level in Figures 9 and 10, respectively.

[55] A minority of tokens on the Spanish identification test were coded as partially correct and thus assigned a score of .5. Across all participants, 95 tokens out of 801 (12%) received a score of .5. All other tokens on the Spanish identification test were assigned a score of either 0 (incorrect) or 1 (correct).

Figure 9: Spanish discrimination mean accuracy[56]

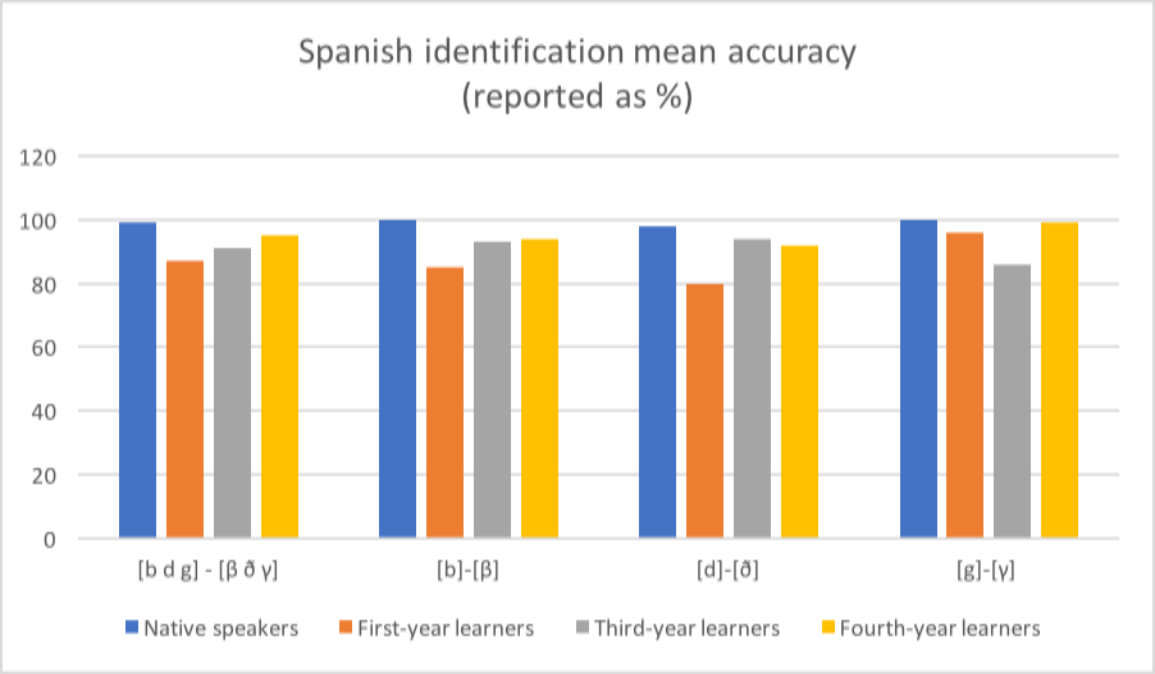


[56] Standard deviations for the Spanish discrimination data are reported in the following table.

Table 16: Standard deviations for Spanish discrimination data

	Native speakers	First-year learners	Third-year learners	Fourth-year learners
[b d g] - [β ð ɣ]	.46	.50	.50	.49
[b]-[β]	.48	.50	.50	.43
[d]-[ð]	.46	.50	.47	.50
[g]-[ɣ]	.46	.50	.50	.50

Figure 10: Spanish identification mean accuracy[57]



As reported in Figure 9, all participants' discrimination accuracy was highest on the [b]-[β] sound pair, while native speakers', first-year learners', and fourth-year learners' discrimination accuracy was lowest on the [g]-[ɣ] sound pair, but third-year learners' discrimination accuracy was lowest on the [d]-[ð] sound pair. The data reported in Figure 10 show that native speakers' identification accuracy on the [b]-[β] and [g]-[ɣ] sound pairs was 100%, while their lowest identification accuracy was 98% on the [d]-[ð] sound pair. First- and fourth-year learners were most accurate in identifying the

[57] Standard deviations for the Spanish identification data are reported in the following table.

Table 17: Standard deviations for Spanish identification data

	Native speakers	First-year learners	Third-year learners	Fourth-year learners
[b d g] - [β ð ɣ]	.06	.27	.21	.17
[b]-[β]	N/A	.30	.19	.19
[d]-[ð]	.11	.32	.19	.22
[g]-[ɣ]	N/A	.14	.23	.08

difference between the [g]-[γ] sound pair and least accurate in identifying the difference between the [d]-[ð] sound pair. Conversely, third-year learners were most accurate in identifying the difference between the [d]-[ð] sound pair and least accurate in identifying the difference between the [g]-[γ] sound pair.

Learners' discrimination accuracy on each individual target sound pair increased slightly on the [g]-[γ] sound pair from the first- to the fourth-years of instruction, but not on the other two sound pairs, as it decreased from the first- to the third-years of instruction and then increased from the third- to the fourth-years of instruction. Although learners' identification accuracy was quite high on each individual target sound pair across levels, it decreased slightly on the [d]-[ð] sound pair from the third- to the fourth-years of instruction and on the [g]-[γ] sound pair from the first- to the third-years of instruction before increasing from the third- to the fourth-years of instruction. These overall perception results are similar to González-Bueno and Quintana-Lara's (2011) findings, discussed in Chapter 2, that learners' perception accuracy on an identification task generally increased across beginning, intermediate, and advanced levels, with a few notable exceptions.

In summary, as observed in Figures 9 and 10, learners' identification accuracy increased across instruction levels, while their discrimination accuracy decreased from the first- to the third-years of instruction but then increased from the third- to the fourth-years of instruction. It is also interesting to point out that while native speakers' identification accuracy was higher than that of all learners, their discrimination accuracy was the lowest among all participant groups. Native Spanish speakers' low discrimination

accuracy is a limitation of this study that will be further discussed in the following chapter. This unexpected finding does however provide insight into L2 Spanish learners' emerging phonological system. It is possible that the learners are more attuned to phonetic differences since their L2 phonological system is not yet fully developed, whereas the native speakers' phonological system is fully developed and so they are only attuned to differences in phonemes (phonemic differences) not to differences in allophones (phonetic differences). In fact, it is not entirely surprising that learners would hear subtle differences in sounds better than native speakers, as it has been previously documented that native speakers often perceive two allophones of a given phoneme, such as /d/, to be the same (Hualde, Olarrea, Escobar, & Travis, 2010). Finally, all participants' identification accuracy was higher than their discrimination accuracy. Kissling (2013a) is one of few previous studies to investigate L2 learners' production and perception of Spanish voiced approximants and although she did not find any significant correlations for first-, second-, or third-year learners' performance on the discrimination and identification tasks for any of the voiced approximants, she found that learners significantly improved their identification accuracy on all target sounds, while they significantly improved their discrimination of [ð]-[d] and [ɣ]-[g] only. Having presented the Spanish production and perception results separately, we will now turn our attention to the correlation analyses to determine whether there is a relationship between production and perception.

5.4 Correlation Analyses on the Spanish Production and Perception Data

The results of the correlation analyses on the Spanish production and perception data are reported in this section. As explained in Chapter 4, only degree of oral constriction was correlated to discrimination and identification accuracy, in separate analyses, because the other production measurements for voiced stops and approximants were different. Furthermore, since separate oral constriction measurements were made for the stops and approximants while for perception, there is just one value for each voiced stop/approximant pair per speaker on the discrimination and identification tests, the difference between stop oral constriction and approximant oral constriction was calculated to obtain a single production value for each stop/approximant pair and correlated to discrimination and identification accuracy. First, the results of the analyses correlating Spanish production and discrimination accuracy for the entire data set overall with all native speakers and learners grouped together in addition to the correlation analyses performed on subsets of the data with regard to the independent variable, instruction level, are reported. The results of the analyses correlating Spanish production and identification accuracy for the entire data set overall and those on each individual participant level are then presented.

No relationship was found between all participants' production, measured as the difference in oral constriction between voiced stops and approximants, and accuracy in discriminating approximants from voiced stops, as indicated by Pearson's *r* which is near

0 and the *p* value of over .05 (*r* (25) = -.041, *p* = .841, two-tailed).[58] Similarly, separate analyses on native speakers' (*r* (2) = .049, *p* = .951, two-tailed), first- (*r* (4) = .246, *p* = .638, two-tailed), third- (*r* (7) = -.056, *p* = .886, two-tailed), and fourth-year learners' (*r* (6) = .120, *p* = .777, two-tailed) production and discrimination accuracy revealed no relationship between the data because all *p* values are over .05. In addition, no relationship was found between all participants' production and identification accuracy because although Pearson's *r* is not near 0, the *p* value is above .05 (*r* (25) = .278, *p* = .160, two-tailed). Native speakers' (*r* (2) = -.201, *p* = .799, two-tailed), first- (*r* (4) = -.275, *p* = .598, two-tailed), and fourth-year learners' (*r* (6) = -.415, *p* = .307, two-tailed) production and identification accuracy were similarly not correlated, as indicated by the *p* values above .05. However, third-year learners' production and identification accuracy were positively and strongly correlated (*r* (7) = .752, *p* < .019, two-tailed).

The presentation of the results of the correlation analyses in this section concludes the discussion of the Spanish results. The Italian results are presented in the following sections, beginning with production in Section 5.5, followed by perception in Section 5.6, and concluding with the correlation analyses in Section 5.7.

5.5 Italian Production Results

The results of the acoustic analysis on Italian intervocalic voiced singleton and geminate stops are reported in this section. Similar to the variation in the manner of articulation of target voiced approximants in Spanish produced by L2 learners, and to a

[58] Citing Cohen (1988), Eddington (2015) states "if *r* is around .1 (or .-1), the correlation is weak. Correlations around .3 (or -.3) are considered moderate, and those around .5 and greater (or -.5 and smaller) are considered to indicate a strong relationship between the two variables" (p. 29).

much lesser degree native speakers, reported in Section 5.2, there was variation in the manner of articulation of target voiced singleton and geminate stops in Italian produced by both L2 learners and native speakers. The frequency of the different productions for /b d g/ and /b: d: g:/, which included complete stops, incomplete stops, approximants, and fricatives, between L1 and L2 speakers is presented in Tables 18 and 19 below. In addition, the descriptive statistics, mean and standard deviation, for each of the following measurements in ms made on all tokens of intervocalic /b d g/ and /b: d: g:/: preceding vowel duration, overall duration of stop consonant, closure duration, release duration, and the C/V ratio are reported in this section. In order to examine the degree to which speakers distinguish between Italian voiced singleton and geminate stops, the descriptive statistics for each cue are reported in a series of tables (20-27), which present the data for the singleton stops first followed by the data for the geminate stops.

Table 18: Frequency of different productions for target voiced singleton stops

Participant level	Manner of articulation
Native speakers	Complete stop: 129/150; 86%
	Incomplete stop: 19/150; 13%
	Approximant: 2/150; 1%
	Fricative: 0/150; 0%
First-year learners	Complete stop: 167/239; 70%
	Incomplete stop: 35/239; 15%
	Approximant: 32/239; 13%
	Fricative: 5/239; 2%
Third-year learners	Complete stop: 123/177; 69%
	Incomplete stop: 5/177; 3%
	Approximant: 47/177; 27%
	Fricative: 2/177; 1%
Fourth-year learners	Complete stop: 143/177; 81%
	Incomplete stop: 10/177; 6%
	Approximant: 23/177; 13%
	Fricative: 1/177; 0%

As observed in Table 18, there was expectedly more variation in L2 learners' production of target voiced singleton stops than in native speakers' productions. Native speakers produced target voiced singleton stops as such 86% of the time, as incomplete stops without a release burst 13% of the time, and as approximants 1% of the time. First-year learners produced target voiced singleton stops as such less frequently than native speakers, while they produced target voiced singleton stops as incomplete stops, approximants, and fricatives more frequently than native speakers. Third-year learners produced target sounds as complete stops with a slightly lower frequency than first-year learners. Moreover, while the frequency of incomplete stop and fricative productions decreased from the first- to the third-years of instruction, the frequency of approximant productions increased from 13% to 27%. Finally, fourth-year learners produced target sounds as complete stops with the greatest frequency among the three learner groups at 81% of the time. While fourth-year learners' production of incomplete stops was slightly greater than third-year learners' production, their production of approximants and fricatives was less frequent than that of third-year learners.

Previous L2 studies on the Italian singleton/geminate stop contrast have not documented this variation in manner of articulation of either singleton or geminate stops; however, it has been documented in Stevens' (2012) study on syntactic gemination (*raddoppiamento sintattico*) of voiceless stops in L1 Sienese Italian. Although the target sounds under investigation in Stevens' (2012) study and the present study are different, it is still helpful to briefly consider her results with respect to variation in manner of articulation. Stevens found that 42.6% of target voiceless singleton stops were produced

as voiceless fricatives and 15.5% were produced as voiced approximants, while just 3.2% were realized as complete stops with a visible closure and release burst.[59] Stevens also found that 66% of target voiceless geminate stops were produced with full occlusion without preaspiration, 4% were produced as fricatives, and 1% were produced as incomplete stops without a release burst.[60] This variation in the production of Italian voiceless stops may be attributed to dialect influence or lenition in intervocalic position, and although /b d g/ are traditionally described as stops in standard Italian, it would not be unexpected for L1 Italian speakers to similarly produce them as approximants some of the time either because of dialect influence or lenition in intervocalic context. In fact, native speakers in the present study produced two of the 150 (1%) target voiced singleton stops as approximants. Overall, 13% to 27% of learners' non-stop pronunciations for /b d g/ were approximants, which is higher than native speakers' production; however, since native speakers do produce /b d g/, albeit rarely, as approximants, learners' production should not be considered entirely non-target-like. In addition, since native speakers in the present study produce target voiced singleton stops as incomplete stops 13% of the time, learners' incomplete stop productions, which range from 3% to 15%, should also not be considered non-target-like. However, since no native speakers produced target /b d g/ as fricatives, learners' few fricative productions, eight total across instruction levels, should

[59] Stevens (2012) found seven phonetic variants for target /p t k/, including voiced glottal fricatives, preaspirated fricatives, voiceless glottal fricatives, and elisions in addition to the three variants reported above. These other four variants were not reported above because they were not found in the present data.

[60] Stevens (2012) found an additional phonetic variant for target /p: t: k:/: preaspirated stops. This variant was not reported above because it was not found in the present data.

not be considered target-like. The variation in the manner of articulation of target voiced geminate stops is reported in Table 19 below.

Table 19: Frequency of different productions for target voiced geminate stops

Participant level	Manner of articulation
Native speakers	Complete stop: 141/150; 94%
	Incomplete stop: 9/150; 6%
	Approximant: 0/150; 0%
	Fricative: 0/150; 0%
First-year learners	Complete stop: 199/239; 83%
	Incomplete stop: 29/239; 12%
	Approximant: 9/239; 4%
	Fricative: 2/239; 1%
Third-year learners	Complete stop: 131/177; 74%
	Incomplete stop: 6/177; 3%
	Approximant: 37/177; 21%
	Fricative: 3/177; 2%
Fourth-year learners	Complete stop: 162/177; 92%
	Incomplete stop: 7/177; 4%
	Approximant: 8/177; 4%
	Fricative: 0/177; 0%

There is comparatively less variation in the manner of articulation of target voiced geminate stops among native speakers and across the three groups of L2 learners than in the manner of articulation of target voiced singleton stops. Native speakers produced target voiced geminate stops as stops 100% of the time; 94% of the time as complete stops and just 6% of the time as incomplete stops. Among the three groups of learners, fourth-year learners produced complete stops with the highest frequency at 92%, followed by first-year learners at 83%, and third-year learners at 74%. First-year learners produced incomplete stops most frequently at 12% of the time, while incomplete stops did not account for a large portion of third- or fourth-year learners' production. Third-year learners produced approximants with the highest frequency, 21%, while first- and

fourth-year learners produced approximants just 4% of the time. Only first- and third-year learners produced fricatives for target /b: d: g:/, but just 1% and 2% of the time, respectively. However, because native speakers did not produce any target voiced geminate stops as approximants or fricatives, these productions in the learners' data are not considered target-like. Finally, overall, 3% to 12% of learners' productions for target voiced geminate stops were incomplete stops, which is higher than native speakers' production; however, since native speakers do produce /b: d: g:/ as incomplete stops some of the time, learners' production should not be considered entirely non-target-like.

Having reported the variation in the manner of articulation of target voiced singleton and geminate stops, we will now turn our attention to the results of the acoustic analysis. To allow for a direct comparison of the data, the descriptive statistics for target singleton stops are presented in a series of tables immediately preceding tables that present the descriptive statistics for target geminate stops.

Table 20: Descriptive statistics for Italian intervocalic /b d g/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	196.79 (36.37)	106.86 (21.64)	91.32 (18.56)	.56 (.17)
First-year learners	161.36 (36.41)	92.42 (34.76)	78.19 (35.45)	.62 (.31)
Third-year learners	175.26 (47.06)	103.34 (34.74)	86.77 (34.73)	.64 (.29)
Fourth-year learners	157.37 (38.43)	106.27 (38.94)	89.63 (37.91)	.75 (.47)

Table 21: Descriptive statistics for Italian intervocalic /b: d: g:/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	110.95 (25.65)	266.85 (36.91)	246.01 (37.39)	2.55 (.80)
First-year learners	167.86 (52.97)	138.09 (61.01)	120.10 (60.54)	.91 (.51)
Third-year learners	185.38 (75.91)	187.80 (99.31)	171.64 (99.59)	1.28 (1.00)
Fourth-year learners	145.44 (40.61)	185.45 (64.15)	166.02 (66.56)	1.45 (.86)

Table 22: Descriptive statistics for Italian intervocalic /b/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	185.60 (32.56)	112.04 (19.63)	103.70 (16.85)	.62 (.16)
First-year learners	150.12 (31.86)	105.18 (35.72)	96.45 (34.15)	.74 (.32)
Third-year learners	155.06 (28.81)	117.39 (42.31)	106.32 (40.42)	.78 (.30)
Fourth-year learners	144.18 (31.70)	122.67 (39.67)	113.80 (40.30)	.94 (.54)

Table 23: Descriptive statistics for Italian intervocalic /b:/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	101.84 (20.49)	270.40 (35.08)	260.64 (35.92)	2.77 (.72)
First-year	157.92 (47.84)	145.75 (59.48)	132.91	1.02 (.55)

learners			(58.25)	
Third-year learners	175.68 (67.32)	204.39 (92.52)	194.34 (91.47)	1.37 (.80
Fourth-year learners	127.73 (35.92)	209.79 (61.74)	198.60 (62.79)	1.84 (1.02)

Table 24: Descriptive statistics for Italian intervocalic /d/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	212.54 (39.31)	92.46 (17.07)	80.92 (15.23)	.45 (.13)
First-year learners	178.14 (39.66)	79.04 (31.08)	66.70 (31.50)	.48 (.26)
Third-year learners	196.73 (58.56)	89.49 (29.99)	76.69 (29.36)	.51 (.26)
Fourth-year learners	177.75 (38.72)	85.38 (32.16)	71.18 (31.83)	.51 (.23)

Table 25: Descriptive statistics for Italian intervocalic /d:/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	117.78 (26.09)	265.44 (39.19)	248.86 (38.42)	2.39 (.78)
First-year learners	180.49 (60.90)	123.35 (51.92)	107.33 (52.09)	.78 (.47)
Third-year learners	211.31 (87.05)	164.91 (89.33)	149.93 (89.58)	.98 (.69)
Fourth-year learners	168.18 (39.32)	165.68 (68.02)	149.25 (69.09)	1.08 (.62)

Table 26: Descriptive statistics for Italian intervocalic /g/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	192.04 (31.65)	116.46 (20.38)	89.27 (16.04)	.62 (.15)
First-year learners	154.80 (30.66)	93.85 (32.78)	72.11 (33.89)	.64 (.30)
Third-year learners	165.07 (31.29)	109.22 (28.73)	84.76 (31.21)	.70 (.26)
Fourth-year learners	146.83 (34.56)	114.58 (35.48)	88.58 (29.98)	.86 (.49)

Table 27: Descriptive statistics for Italian intervocalic /g:/, mean and standard deviation (in parentheses)

Participant level	Preceding vowel duration (ms)	Overall stop duration (ms)	Closure duration (ms)	C/V ratio (ms)
Native speakers	113.22 (27.61)	264.72 (36.84)	228.52 (30.75)	2.50 (.86)
First-year learners	164.76 (46.69)	145.76 (68.86)	120.41 (68.58)	.94 (.49)
Third-year learners	162.44 (58.55)	201.27 (112.27)	178.51 (113.51)	1.55 (1.34)
Fourth-year learners	137.65 (35.15)	184.05 (55.04)	153.96 (56.89)	1.48 (.76)

As reported in Tables 20 through 27, only fourth-year learners consistently produced vowels preceding geminates with shorter durations than those preceding singletons, which is in line with the native speaker data in the present study and with the results of previous L1 Italian studies on the singleton/geminate stop contrast (Chang, 2000; Esposito & Di Benedetto, 1999; Pickett et al., 1999). In all cases, first-year learners

produced vowels preceding geminates with longer durations than those preceding singletons, while third-year learners produced vowels preceding /b:/ and /d:/ with longer durations than those preceding their singleton counterparts but vowels preceding /g:/ with shorter durations than those preceding its singleton counterpart. It is not surprising that most learners in the present study lengthened the duration of vowels preceding geminates because in a L2 perception study on the length contrast between Italian /t/ and /t:/, Rochet and Rochet (1995) found that some of their native English-speaking participants incorrectly associated a long vowel with a long consonant and a short vowel with a short consonant. However, the results of two previous studies on L2 learners from different L1 backgrounds are different. The participants in Celata and Costamagna's (2011) study who were native speakers of Estonian, which has a consonant length contrast, with a low level of proficiency in Italian consistently produced vowels preceding geminates with shorter durations than vowels preceding singletons. More recently, De Clercq et al. (2014) found that native speakers of Dutch who were beginning learners of Italian produced vowels preceding geminates with shorter durations than those preceding singletons.

In addition, although learners' overall mean durations for geminates were longer than their corresponding singleton counterparts, they were not approximately twice as long as their singleton counterparts, as found in the native speakers' data in the present study and as reported in previous L1 studies (Cerrato & Falcone, 1998; Chang, 2000; Esposito & Di Benedetto, 1999; Pickett et al., 1999). L2 Italian learners' difficulty in doubling the length of geminates has similarly been documented in previous L2 studies (Celata & Costamagna, 2011; De Clercq et al., 2014; Kabak et al., 2011). This finding

suggests that learners are in the process of acquiring the length contrast between singletons and geminates, as they do differentiate between each type of stop consonant, but not yet in a target-like fashion. This claim is supported by learners' mean closure durations which were greater for geminate stops than singleton stops in all cases, as in the native speakers' data. Finally, the C/V ratio provides further insight into whether speakers successfully distinguish between singletons and geminates. Following Pickett et al. (1999), a C/V ratio of 1.0 was used as a cut-off between the two categories of stop consonants. Fourth-year learners' mean C/V ratios for geminates were consistently above 1.0. Third-year learners' mean C/V ratios for geminates were above 1.0 in all cases except for /d:/, which at .98 fell just short of the cut-off. Finally, only first-year learners' mean C/V ratio of 1.02 for /b:/ was greater than 1.0. Native speakers' mean C/V ratios were well above 2.0 in all cases. De Clercq et al. (2014) is the only previous L2 study on the Italian singleton/geminate contrast to examine the C/V ratio and similarly found that learners' mean C/V ratios for geminates were above 1.0.

In summary, there is expectedly variation in L2 learners' production of voiced singleton and geminate stops across instruction levels. The data reported in Tables 20 through 27 show that some learner groups better approximate native speakers' production on certain cues such as overall stop duration and closure duration for all three singletons combined, while they are still in the process of acquiring others such as shortening the duration of the vowel preceding geminates and sufficiently lengthening the overall duration of geminate stops and their closure duration to successfully distinguish geminates from singletons in a target-like fashion. Turning our attention to the Italian

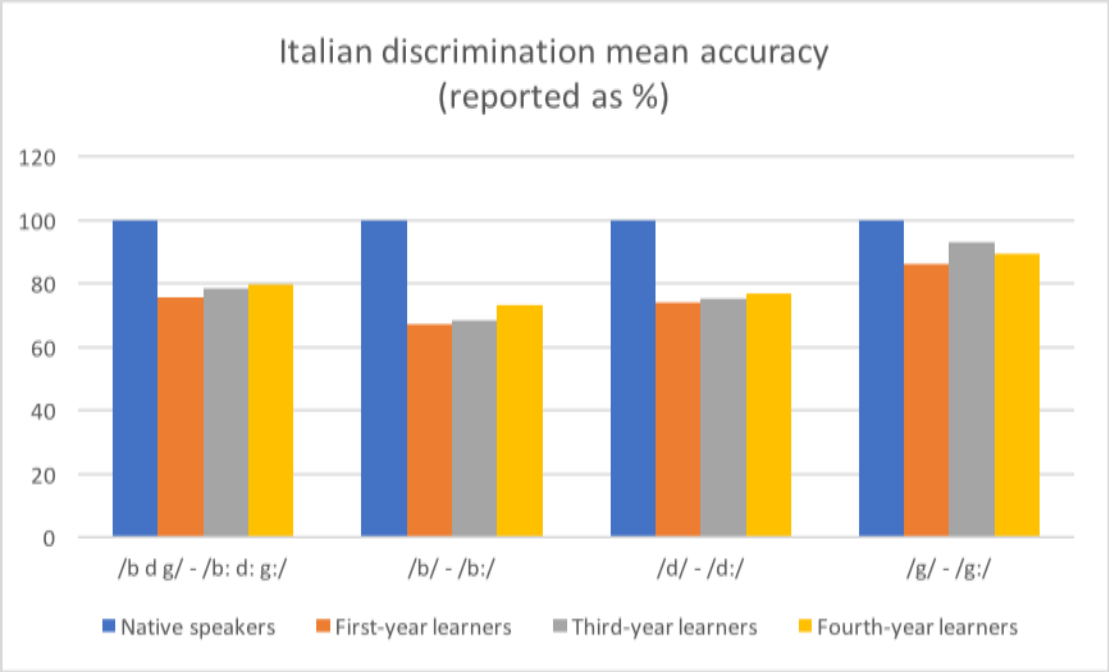
perception data, the results of the discrimination and identification tests are presented in the following section.

5.6 Italian Perception Results

The results of the discrimination and identification tests, which comprised the Italian perception task, are reported in this section. As explained in Chapter 4, the Spanish and Italian perception data were analyzed following the same methods - correct responses on the discrimination test were assigned 1 point (i.e., the participant chose "different") and incorrect responses were assigned 0 points (i.e., the participant chose "same"), while participants' responses on the identification test were assigned a score of 1, .5, or 0.[61] After all participant responses were coded, descriptive statistics, mean accuracy and standard deviation, were obtained from SPSS. The descriptive statistics for the discrimination and identification data are reported by participant level in Figures 11 and 12, respectively.

[61] A minority of tokens on the Italian identification test were coded as partially correct and thus assigned a score of .5. Across all participants, 54 tokens out of 743 (7%) received a score of .5. All other tokens on the Italian identification test were assigned a score of either 0 (incorrect) or 1 (correct).

Figure 11: Italian discrimination mean accuracy[62]



As indicated in Figure 11, L2 Italian learners' mean discrimination accuracy increased from the first- to the fourth-years of instruction on all three target sound pairs and on the /b/-/b:/ and /d/-/d:/ sound pairs. On the /g/-/g:/ sound pair, learners' discrimination accuracy increased from the first- to the third-years of instruction, but then decreased slightly from the third- to the fourth-years of instruction. Overall, while learners' discrimination accuracy, across instruction levels, is quite high, it is lower than first-year Italian learners' accuracy in a similar study by De Clercq et al. (2014) who

[62] Standard deviations for the Italian discrimination data are reported in the following table.

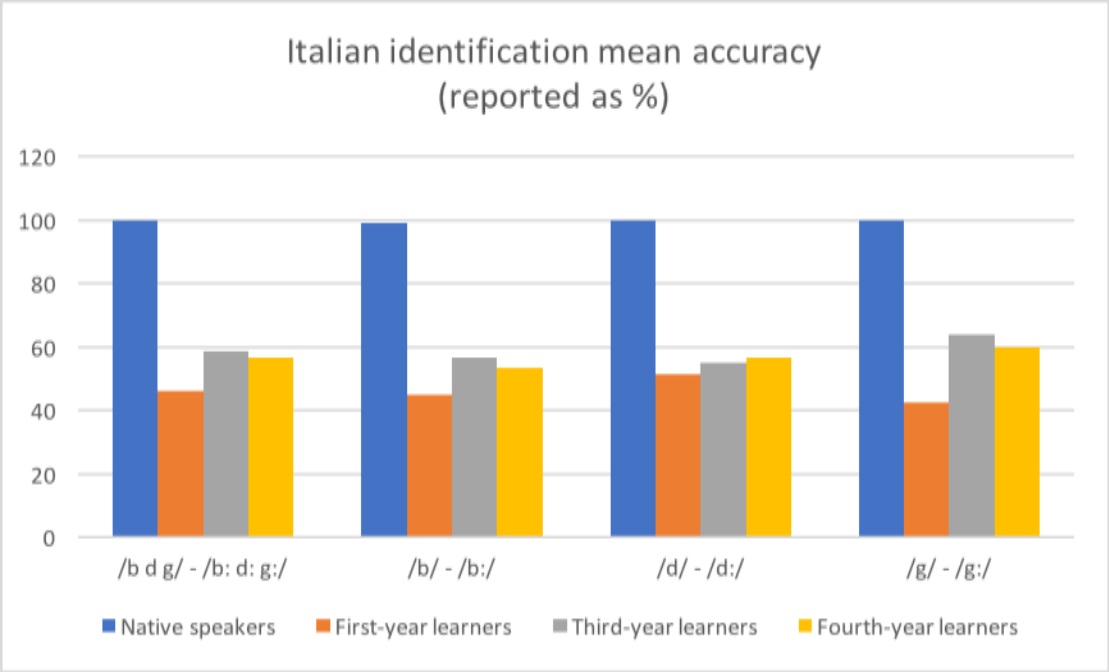
Table 28: Standard deviations for Italian discrimination data

	Native speakers	First-year learners	Third-year learners	Fourth-year learners
/b d g/ - /b: d: g:/	N/A	.43	.41	.40
/b/ - /b:/	N/A	.47	.47	.45
/d/ - /d:/	N/A	.44	.44	.43
/g/ - /g:/	N/A	.35	.26	.31

investigated L2 production and perception of /p/-/p:/, /t/-/t:/, and /s/-/s:/. Learners in De Clercq et al.'s study completed an AXB discrimination task with 92.5% to 96.7% mean accuracy on all three target sound pairs. Although the learners in De Clercq et al.'s study had studied Italian for less time than most learners in the present study, they were more accurate in discriminating voiced geminate stops from voiced singleton stops.

It is also interesting to note that learners' accuracy in discriminating the geminate stop from its corresponding singleton counterpart increases as the place of articulation moves further backwards in the vocal tract, such that learners from all levels are most accurate in discriminating the difference between the velar stops /g/-/g:/ and least accurate in discriminating the difference between the bilabial stops /b/-/b:/. De Clercq et al. (2014) similarly found that learners more accurately perceived length differences in consonants produced further backwards in the oral cavity, i.e., alveolar /s/ and dental /t/ than bilabial /p/. It is possible that the length difference between the velar stops was the most perceptually salient to L2 learners in the present study because as González-Bueno (1994) proposed in her study on L2 acquisition of Spanish voiceless and voiced stops, since velar stops are acquired last in English, they are least resistant to modification and hence more unstable when learning another language. Finally, as expected, native speakers in the present study were more accurate than all learners in discriminating the difference between all voiced singleton and geminate stops, with 100% accuracy in all cases.

Figure 12: Italian identification mean accuracy[63]



As indicated in Figure 12, L2 Italian learners' mean identification accuracy consistently increased from the first- to the third-years of instruction on all three target sound pairs and on each individual target sound pair. This increase in accuracy was followed however by a decrease in accuracy in the highest-level learners in most cases. On all three target sound pairs and on the individual target sound pairs /b/-/b:/ and /g/-/g:/, there was a decrease in learners' accuracy, albeit it rather small, from the third- to the fourth-years of instruction. In addition, while learners' accuracy in discriminating the

[63] Standard deviations for the Italian identification data are reported in the following table.

Table 29: Standard deviations for Italian identification data

	Native speakers	First-year learners	Third-year learners	Fourth-year learners
/b d g/ - /b: d: g:/	.04	.48	.47	.48
/b/ - /b:/	.07	.48	.48	.49
/d/ - /d:/	N/A	.48	.48	.48
/g/ - /g:/	N/A	.47	.44	.47

geminate stop from its corresponding singleton counterpart increases as the place of articulation moves further backwards in the vocal tract, this trend was only observed in the fourth-year learners on the identification task. Finally, as expected, native speakers were more accurate than all learners in identifying the length difference between all voiced singleton and geminate stops, with 99% to 100% accuracy.

In summary, the perception data presented in Figures 11 and 12 indicate that L2 Italian learners are able to discriminate voiced geminate stops from their corresponding singleton counterparts with a fairly high degree of accuracy, ranging from 75.7% to 79.7% on all three target sound pairs, but they struggle to identify this length difference with an overall mean accuracy ranging from 46.2% to 56.5%. These results suggest that while learners generally perceive a difference between voiced singleton and geminate stops, they have not yet acquired the ability to consistently identify the length difference that distinguishes the two categories of stop consonants. Having presented the Italian production and perception results separately, the results of the correlation analyses are reported in the final section of this chapter to determine whether there is a relationship between Italian production and perception.

5.7 Correlation Analyses on the Italian Production and Perception Data

The results of the correlation analyses on the Italian production and perception data are presented in this section. As explained in Chapter 4, since there are separate values for each acoustic cue (preceding vowel duration, overall stop duration, closure duration, and C/V ratio) associated with each speaker's production of singletons and

corresponding geminates in Italian, the difference between singletons and geminates on each of the first three cues was calculated and in addition to the C/V ratio for geminates was correlated to discrimination and identification accuracy in separate analyses. Correlation analyses were performed on the entire data set overall with all native speakers and learners grouped together in addition to subsets of the data with regard to the independent variable, instruction level. The results of the correlation analyses are reported by phonetic cue.

No relationship was found between all participants' production, measured as the difference in closure duration between voiced singleton stops and their geminate counterparts, and accuracy in discriminating voiced geminate stops from voiced singleton stops because although Pearson's *r* is not near 0, the *p* value is above .05 (r (23) = .280, p = .175, two-tailed). Separate analyses on first- (r (6) = -.530, p = .176, two-tailed), third- (r (4) = -.093, p = .860, two-tailed), and fourth-year learners' (r (4) = .356, p = .488, two-tailed) production and discrimination accuracy similarly revealed that the data were not correlated. All participants' production, measured as the closure duration difference between voiced singleton and geminate stops, and accuracy in identifying the length difference between voiced singleton and geminate stops were positively and moderately to strongly correlated (r (23) = .408, p < .043, two-tailed).[64] In addition, first-year learners' production and identification accuracy were negatively and strongly correlated (r (6) = -.798, p < .018, two-tailed). However, third- (r (4) = -.040, p = .940, two-tailed)

[64] Citing Cohen (1988), Eddington (2015) states "if *r* is around .1 (or .-1), the correlation is weak. Correlations around .3 (or -.3) are considered moderate, and those around .5 and greater (or -.5 and smaller) are considered to indicate a strong relationship between the two variables" (p. 29).

and fourth-year learners' (r (4) = .492, p = .322, two-tailed) production and identification accuracy were not correlated given the high p values.

The analysis on all participants' production, measured as the difference in the overall durations of voiced singleton and geminate stops, and discrimination accuracy also revealed that the data were not correlated because although Pearson's r is not near 0, the p value is above .05 (r (23) = .305, p = .138, two-tailed). Separate analyses on first- (r (6) = -.465, p = .246, two-tailed), third- (r (4) = -.084, p = .874, two-tailed), and fourth-year learners' (r (4) = .394, p = .439, two-tailed) production and discrimination accuracy similarly revealed that the data were not correlated given the high p values. However, there was a positive and moderate to strong correlation between all participant's production, measured as the difference in the overall durations of voiced singleton and geminate stops, and identification accuracy (r (23) = .425, p < .034, two-tailed). In addition, first-year learners' production and identification accuracy were negatively and strongly correlated (r (6) = -.774, p < .024, two-tailed). However, third- (r (4) = -.029, p = .956, two-tailed) and fourth-year learners' (r (4) = .533, p = .276, two-tailed) production and identification accuracy were not correlated given the high p values.

All participants' production, measured as the difference in preceding vowel durations, and discrimination accuracy were not correlated because although Pearson's r is not near 0, the p value is above .05 (r (23) = .311, p = .130, two-tailed). Separate analyses on first- (r (6) = .159, p = .707, two-tailed) and third-year learners' (r (4) = -.377, p = .461, two-tailed) production and discrimination accuracy similarly revealed that the data were not correlated given the high p values. However, fourth-year learners'

production and discrimination accuracy were positively and strongly correlated (r (4) = 1.000, p < .000, two-tailed). In addition, the analysis on all participants' production, measured as the difference in preceding vowel durations, and identification accuracy revealed a positive and moderate to strong correlation (r (23) = .456, p < .022, two-tailed). However, first- (r (6) = .282, p = .499, two-tailed), third- (r (4) = -.338, p = .513, two-tailed), and fourth-year learners' (r (4) = .216, p = .680, two-tailed) production and identification accuracy were not correlated given the high p values.

Finally, all participants' production, measured as the mean C/V ratio for geminates, and discrimination accuracy were not correlated because although Pearson's r is not near 0, the p value is above .05 (r (23) = .267, p = .197, two-tailed). Separate analyses on first- (r (6) = -.356, p = .387, two-tailed), third- (r (4) = -.284, p = .585, two-tailed), and fourth-year learners' (r (4) = -.085, p = .873, two-tailed) production and discrimination accuracy similarly revealed that the data were not correlated given the high p values. The correlation between all participants' production, measured as the mean C/V ratio for geminates, and identification accuracy was not significant, but was approaching significance (r (23) = .394, p = .051, two-tailed). First- (r (6) = -.619, p = .102, two-tailed), third- (r (4) = -.253, p = .629, two-tailed), and fourth-year learners' (r (4) = .227, p = .665, two-tailed) production and identification accuracy were also not correlated given the high p values.

In the final chapter that follows, the results of the present study are discussed in the context of the research questions, hypotheses, and Flege's (1995) Speech Learning Model (SLM) that were presented in Chapter 1. In addition, the conclusions and

contributions of this study are summarized in the following chapter, and limitations of the present study and directions for future research regarding L2 acquisition of the allophonic alternation between Spanish word-initial voiced stops [b d g] and intervocalic voiced approximants [β ð γ] and of the phonemic contrast between Italian intervocalic voiced singleton stops /b d g/ and voiced geminate stops /b: d: g:/ are also addressed in the following chapter.

Chapter 6 Discussion and Conclusion

6.1 Introduction

In the following section, the results of the present study are discussed in the context of the research questions, hypotheses, and Flege's (1995) Speech Learning Model (SLM) that were presented in Chapter 1. The conclusions and contributions of this study are then summarized in Section 6.3. Finally, limitations of the present study and directions for future research regarding L2 acquisition of the allophonic alternation between Spanish word-initial voiced stops [b d g] and intervocalic voiced approximants [β ð γ] and of the phonemic contrast between Italian intervocalic voiced singleton stops /b d g/ and voiced geminate stops /b: d: g:/ are addressed in Sections 6.4 and 6.5, respectively.

6.2 Discussion of Results

6.2.1 Research Question #1

The first research question asked whether L2 learners are more accurate in producing or perceiving the sounds associated with allophonic and phonemic contrasts in their respective L2. In other words, are L2 Spanish learners more accurate in producing or perceiving voiced stops and approximants? Are L2 Italian learners more accurate in producing or perceiving Italian voiced singleton and geminate stops? As explained in Chapter 4, production accuracy scores were calculated, per learner group, to directly compare learners' accuracy on the production and perception tasks in their respective L2

to answer the first research question. The production accuracy scores for the Spanish word-initial and intervocalic data are presented, per learner level and measure, in Tables 30 and 31, respectively.[65]

Table 30: Production accuracy scores for Spanish word-initial data

Learner level	Prevoicing	Voicing lag	Intensity difference	Overall accuracy
First-year learners	20%	80%	95%	65%
Third-year learners	28%	80%	96%	68%
Fourth-year learners	40%	93%	97%	77%

While learners' prevoicing accuracy ranges from 20% to 40%, as reported in Table 30, it is important to point out that this does not mean that 20% to 40% of all word-initial voiced stops learners produced were prevoiced, but rather that 20% to 40% of the tokens they produced with voicing lead fell within the native speakers' voicing lead range, as not all learners' production of prevoicing fell within the native speaker range.[66] Since not all tokens of word-initial [b d g] were produced with voicing lag by learners, the voicing lag accuracy scores indicate that 80% to 93% of the tokens learners produced with voicing lag were within the native speakers' range. In other words, when learners produced target voiced stops with voicing lag, they were usually within the native

[65] As explained in Chapters 4 and 5, consonant valley and following vowel peak measurements were made for target Spanish word-initial voiced stops and intervocalic voiced approximants to calculate the mean intensity difference between target consonants and the following vowel. Since how small or large the intensity difference between the valley of the consonant and the peak of the following vowel is of greater interest than the actual peak and valley measurements, the mean peak and valley measurements were not discussed in Chapter 5 and accuracy scores were not calculated for these two measures but rather for the intensity difference.

[66] As reported in Chapter 5, first-, third-, and fourth-year learners produced [b d g] with prevoicing 24%, 28%, and 44% of the time, respectively.

speakers' voicing lag range. Finally, since there was no variation in the manner of articulation of target voiced stops produced by learners, as they produced all tokens of word-initial [b d g] as stops, the accuracy scores suggest that learners produced target voiced stops with an intensity difference that was within the native speaker range 95% to 97% of the time. The accuracy scores for each of these three subcomponent measures were then averaged to obtain an overall production accuracy score for Spanish word-initial voiced stops per learner level, and as reported in Table 30, ranges from 65% to 77%.

Table 31: Production accuracy scores for Spanish intervocalic data

Learner level	Intensity difference
First-year learners	85%
Third-year learners	81%
Fourth-year learners	91%

Given the variation in the manner of articulation of target approximants produced by learners, reported in Chapter 5, it is important to point out that the accuracy scores in Table 31 do not suggest that learners accurately produced target approximants 81% to 91% of the time. As reported in Chapter 5, only 23% to 41% of first- through fourth-year learners' productions of intervocalic /b d g/ were approximants. The accuracy scores in Table 31 indicate that when learners produced target approximants as such, 81% to 91% of their approximant productions had an intensity difference that was within the native speaker range.

Since learners' perception on the discrimination and identification tests was analyzed for each of the following voiced stop/approximant pairs [b]-[β], [d]-[ð], and [g]-

[γ] while their production of each class of sounds (i.e., voiced stops and approximants) was analyzed separately, the overall production accuracy scores for Spanish word-initial voiced stops and the intensity difference accuracy scores for approximants, which are effectively the overall scores since they are the only ones for approximants, were averaged in order to compare production and perception of all target sounds [b d g β ð γ] by learner level. The overall production accuracy scores for all target sounds [b d g β ð γ] are 75%, 75%, and 84% for first-, third-, and fourth-year learners, respectively, meaning that learners' production was within the native speaker range 75% to 84% of the time. As reported in Chapter 5, first-, third-, and fourth-year learners were accurate in discriminating voiced approximants from stops 49%, 43%, and 58% of the time, respectively, while they were accurate in identifying the difference between target sounds 87%, 91%, and 95% of the time, respectively. Averaging learners' discrimination and identification accuracy by learner level yields the following overall perception accuracy scores: 68% for first-year learners, 67% for third-year learners, and 77% for fourth-year learners.

In response to the first research question, a comparison of the overall production and perception accuracy scores by learner level suggests that L2 Spanish learners are more accurate in producing rather than perceiving voiced stops and approximants. As indicated by the results of the identification test reported in Chapter 5 and in the previous paragraph, learners across instruction levels appear to be quite accurate in identifying the difference between target sounds. However, since the written representation of voiced stops and approximants is the same in standard Spanish orthography, it may be argued

that the results of the identification test do not really indicate whether learners do indeed perceive a difference between these sounds. This is a limitation of the study that will be further discussed in Section 6.4. Therefore, the results of the discrimination test may be a better indicator of learners' perception of voiced stops and approximants.

A comparison of learners' discrimination accuracy, by level, and their accuracy on the individual production measures shows that their production accuracy scores are higher on all measures except for prevoicing of [b d g] than their discrimination accuracy. This is an important finding because prevoicing is one of the primary acoustic cues associated with production of Spanish word-initial voiced stops, and it may be argued that the low frequency with which learners' prevoicing falls within the native speaker range, as reported in Table 30, is not indicative of very accurate production. In addition, it is also important to consider the frequency with which learners produced target approximants as such when addressing the question of accuracy. While 81% to 91% of learners' approximant productions had an intensity difference that was within the native speaker range, it is important to recall that learners only produced target approximants as such 23% to 41% of the time, meaning that 59% to 77% of the time they produced target approximants as something different (e.g., stop). It can therefore be argued that the frequency with which learners' approximant productions had a native-like intensity difference should not be considered a better indicator of learners' accuracy than the actual frequency with which they produced target approximants as such, which is quite low.

In summary, if the overall production and perception accuracy scores previously reported are used to address the first research question about learners' accuracy, then, as previously stated, L2 Spanish learners are more accurate in producing rather than perceiving voiced stops and approximants, which does not confirm the first hypothesis that L2 Spanish learners would be more accurate in perceiving rather than producing voiced stops and approximants. If however learners' discrimination accuracy, prevoicing accuracy, and the frequency with which they produced target approximants as such are used to address the first research question, then, in support of the first hypothesis, L2 Spanish learners are more accurate in perceiving rather than producing voiced stops and approximants, as their discrimination accuracy was higher than their prevoicing accuracy and approximant frequency across instruction levels. It can be argued that learners' prevoicing accuracy, approximant frequency, and discrimination accuracy better reflect their production and perception accuracy of Spanish voiced stops and approximants than the overall production and perception accuracy scores because the overall production accuracy scores for word-initial [b d g] and intervocalic [β ð γ] include measures on which learners across instruction levels scored high but are not as helpful in determining whether their production is target-like and because the overall perception accuracy scores include learners' identification accuracy, which although is high does not necessarily accurately reflect their perception, as previously stated.

Turning our attention to the Italian data, we will now discuss whether L2 Italian learners are more accurate in producing or perceiving voiced singleton and geminate stops to address the second part of the first research question. As with the Spanish data,

production accuracy scores were calculated, per learner group, to directly compare L2 Italian learners' accuracy on the production and perception tasks. The production accuracy scores for the Italian intervocalic voiced singleton and geminate stops are presented, per learner level and measure, in Tables 32 and 33, respectively.[67]

Table 32: Production accuracy scores for Italian intervocalic voiced singleton stops

Learner level	Preceding vowel duration	Overall stop duration	Closure duration	C/V ratio	Overall accuracy
First-year learners	79%	75%	59%	79%	73%
Third-year learners	84%	86%	73%	80%	81%
Fourth-year learners	77%	84%	73%	74%	77%

The production accuracy scores reported in Table 32 indicate the frequency with which L2 Italian learners' production was within the native speaker range on each individual measure. The production accuracy scores on each individual measure suggest that L2 Italian learners across instruction levels are quite accurate in producing intervocalic voiced singleton stops, as the lowest score was first-year learners' closure duration which was within the native speaker range 59% of the time. The accuracy scores on each of these individual measures were then averaged to obtain an overall production accuracy score for Italian intervocalic voiced singleton stops per learner level, and as reported in Table 32, ranges from 73% to 81%. However, given the variation in the manner of articulation of target voiced singleton stops produced by learners and native

[67] Production accuracy scores were only calculated for the main acoustic cues to the Italian singleton/geminate stop contrast, which are preceding vowel duration, overall stop duration, closure duration, and C/V ratio. Since release duration is not a main acoustic cue to the Italian singleton/geminate stop contrast, production accuracy scores were not calculated for this measure.

speakers, reported in Chapter 5, it is important to also consider the frequency with which target /b d g/ were produced as complete stops. Recall that first-, third-, and fourth-year learners produced target /b d g/ as complete stops 70%, 69%, and 81% of the time, respectively, which is less frequent than native speakers who produced them as complete stops 86% of the time. Other learner productions for /b d g/ included incomplete stops, approximants, and fricatives. Since native speakers produced target /b d g/ as incomplete stops 13% of the time, up to 13% of learners' incomplete stop productions, which ranged from 3% to 15%, should be considered target-like. Similarly, since native speakers produced target /b d g/ as approximants 1% of the time, up to 1% of learners' approximant productions, which ranged from 13% to 27%, should be considered target-like. However, since no native speakers produced target /b d g/ as fricatives, learners' few fricative productions, eight total across instruction levels, should not be considered target-like. A comparison of native speakers' and learners' different productions for target voiced singleton stops reveals that first-, third-, and fourth-year learners produced these sounds in a target-like fashion 84%, 73%, and 87% of the time, respectively, which is quite high.[68]

[68] These percentages include the frequency with which each learner group produced target /b d g/ as complete stops and the frequency up to the native speaker frequency that each group produced the target sounds as incomplete stops and approximants. Therefore, what is meant by target-like is the frequency with which learners' production in terms of manner of articulation was consistent with native speakers' production.

Table 33: Production accuracy scores for Italian intervocalic voiced geminate stops

Learner level	Preceding vowel duration	Overall stop duration	Closure duration	C/V ratio	Overall accuracy
First-year learners	66%	17%	45%	19%	37%
Third-year learners	59%	48%	47%	41%	49%
Fourth-year learners	82%	41%	38%	41%	51%

The production accuracy scores reported in Table 33 indicate the frequency with which L2 Italian learners' production of intervocalic voiced geminates was within the native speaker range on each individual measure. A comparison of the production accuracy scores on each individual measure for target /b d g/ and /b: d: g:/ indicates that learners across instruction levels were more accurate in producing target voiced singleton stops than their geminate counterparts, as learners' accuracy on each individual measure was higher for target voiced singleton stops in all cases except for fourth-year learners' accuracy score for preceding vowel duration. The accuracy scores on each of the individual measures were averaged to obtain an overall production accuracy score for Italian intervocalic voiced geminate stops per learner level, and as reported in Table 33, ranges from 37% to 51%, which is lower than the overall production accuracy scores for target singleton stops reported in Table 32.

In addition, given the variation in the manner of articulation of target voiced geminate stops produced by learners and native speakers, reported in Chapter 5, it is important to also consider the frequency with which target /b: d: g:/ were produced as complete stops. Recall that first-, third-, and fourth-year learners produced target /b: d: g:/

as complete stops 83%, 74%, and 92% of the time, respectively, which is less frequent than native speakers who produced them as complete stops 94% of the time. Since native speakers produced target voiced geminate stops as incomplete stops 6% of the time, up to 6% of learners' incomplete stop productions, which ranged from 3% to 12%, should be considered target-like. However, since no native speakers produced target /b: d: g:/ as approximants or fricatives, learners' approximant and fricative productions should not be considered target-like. A comparison of native speakers' and learners' different productions for target voiced geminate stops reveals that first-, third-, and fourth-year learners produced these sounds in a target-like fashion 89%, 77%, and 96% of the time, respectively, which is quite high.[69] Although learners across instruction levels were quite accurate in producing target voiced geminate stops in terms of manner of articulation, they were nevertheless generally considerably less accurate in their phonetic implementation of geminates, as indicated by the accuracy scores on each individual measure in Table 33.

Since learners' perception on the discrimination and identification tests was analyzed for each of the following voiced singleton/geminate stop pairs /b/-/b:/, /d/-/d:/, and /g/-/g:/ while their production of each class of sounds (i.e., voiced singletons and geminates) was analyzed separately, the overall production accuracy scores for Italian intervocalic voiced singleton and geminate stops were averaged in order to compare production and perception of all target sounds /b d g b: d: g:/ by learner level. The overall

[69] These percentages include the frequency with which each learner group produced target /b: d: g:/ as complete stops and the frequency up to the native speaker frequency that each group produced the target sounds as incomplete stops. Therefore, what is meant by target-like is the frequency with which learners' production in terms of manner of articulation was consistent with native speakers' production.

production accuracy scores for all target sounds /b d g b: d: g:/ are 55%, 65%, and 64% for first-, third-, and fourth-year learners, respectively, meaning that learners' production was within the native speaker range 55% to 65% of the time. As reported in Chapter 5, first-, third-, and fourth-year learners were accurate in discriminating voiced geminate stops from their singleton counterparts 75.7%, 78.5%, and 79.7% of the time, respectively, while they were accurate in identifying the difference between target sounds 46.2%, 58.5%, and 56.5% of the time, respectively. Averaging learners' discrimination and identification accuracy by learner level yields the following overall perception accuracy scores: 60.95% for first-year learners, 68.5% for third-year learners, and 68.1% for fourth-year learners.

In response to the first research question, a comparison of the overall production and perception accuracy scores by learner level indicates that L2 Italian learners are more accurate in perceiving rather than producing Italian intervocalic voiced singleton and geminate stops, which confirms the first hypothesis. This finding therefore suggests that the consonant length contrast in Italian is first acquired by L2 learners in perception and then in production. As previously stated, if L2 Spanish learners' discrimination accuracy, prevoicing accuracy, and the frequency with which they produced target approximants as such are used to address the first research question rather than their overall production and perception accuracy scores, then they are similarly more accurate in perceiving rather than producing the target sounds in their L2. In addition to confirming the first hypothesis, the Spanish and Italian results concur with previous research on L2

production and perception of Spanish stress by Lord (2002) who found that receptive skills are acquired before productive skills.

6.2.2 Research Question #2

The second research question asked how learners at different instruction levels produce and perceive the sounds associated with allophonic and phonemic contrasts in their respective L2. In other words, is there development between levels? As explained in Chapter 4, separate analyses of variance (ANOVA) were performed on the Spanish and Italian production data, with participant level (i.e., native speaker, first-year learner, third-year learner, fourth-year learner) as the independent variable and each phonetic measurement as the dependent variable to answer the second research question about development in learners' production of target sounds between instruction levels.[70] Separate ANOVAs were also performed on the Spanish and Italian perception data, with participant level as the independent variable and mean discrimination accuracy and mean identification accuracy as the dependent variables to answer the second research question about development in learners' perception of target sounds between instruction levels. Post-hoc Tukey HSD tests were subsequently carried out to determine the nature of

[70] As explained in Chapters 4, 5, and Section 6.2.1 of this chapter, consonant valley and following vowel peak measurements were made for target Spanish word-initial voiced stops and intervocalic voiced approximants to calculate the mean intensity difference between target consonants and the following vowel. Since how small or large the intensity difference between the valley of the consonant and the peak of the following vowel is of greater interest than the actual peak and valley measurements, the mean peak and valley measurements were not included in the ANOVAs. In addition, as explained in Section 6.2.1 of this chapter, since release duration is not a main acoustic cue to the Italian singleton/geminate stop contrast, it was not included in the ANOVAs. Separate ANOVAs were performed on the Italian production data with preceding vowel duration, overall stop duration, closure duration, and C/V ratio as the dependent variable since these are the main acoustic cues to the Italian singleton/geminate stop contrast.

significant findings revealed by the ANOVAs. First, the results of the ANOVAs carried out on the Spanish production and perception data are discussed and then the results of the ANOVAs performed on the Italian production and perception data are discussed.

A one-way between subjects ANOVA was conducted to compare the effect of speaker level (independent variable) on the degree to which subjects produced Spanish word-initial voiced stops with prevoicing. A main effect of speaker level was found, F (3, 23) = 4.324, $p < .015$, $\eta^2 = .361$, suggesting that there are significant differences in participants' production of prevoicing.[71] Post-hoc Tukey HSD tests revealed that native speakers expectedly produced Spanish word-initial [b d g] with significantly more prevoicing than first- ($p < .021$) and third-year learners ($p < .017$), but not than fourth-year learners ($p = .174$). Post-hoc Tukey HSD testing did not indicate a significant difference between first- and third-year learners' production of prevoicing, $p = .999$, between first- and fourth-year learners' production of prevoicing, $p = .538$, or between third- and fourth-year learners' production of prevoicing, $p = .536$, as learners from all instruction levels produced word-initial [b d g] with a similar degree of prevoicing on average.

The results of the one-way between subjects ANOVA on speaker level and voicing lag also revealed a main effect of speaker level, F (3, 23) = 5.736, $p < .004$, $\eta^2 = .428$, suggesting that there are significant differences in participants' production of Spanish word-initial voiced stops with voicing lag. Post-hoc Tukey HSD tests revealed

[71] Citing Cohen (1988), Eddington (2015) states that "for ANOVA, partial eta^2 values around .01 show a weak effect, those around .06, a medium effect, and values of about .14 and larger, a large effect" (p. 66). Based on this, the value of .361 indicates a large effect size.

significant differences in participants' production of word-initial [b d g] with voicing lag across levels. Specifically, native speakers expectedly produced word-initial [b d g] with significantly less voicing lag than first- ($p < .008$) and third-year learners ($p < .007$), but not than fourth-year learners ($p = .208$). First- and third-year learners' production of voicing lag did not differ significantly ($p = .995$), neither did first- and fourth-year learners' production of voicing lag ($p = .229$), nor third- and fourth-year learners' production of voicing lag ($p = .247$).

Speaker level did not have a main effect on the mean intensity difference between the valley of Spanish word-initial voiced stops and the peak of the following vowel, F (3, 23) = 2.583, $p = .078$, $\eta^2 = .252$, suggesting that there are not significant differences between participants on this measure. Finally, the results of the one-way ANOVA on speaker level and the mean intensity difference between the valley of Spanish intervocalic voiced approximants and the peak of the following vowel similarly did not reveal a main effect of speaker level, F (3, 23) = 1.212, $p = .328$, $\eta^2 = .137$, suggesting that there are not significant differences between participants on this measure. In other words, no group of participants (native speakers or learners from any instruction level) achieved a significantly greater degree of spirantization than other participants, as mean intensity differences were similar across all participant groups.

In summary, while the results of the ANOVAs indicate that there is development in L2 Spanish learners' production of target sounds between instruction levels, this development is not significant. In other words, learners at higher levels of instruction

(i.e., third and fourth year) do not make significantly greater gains than first-year learners on any measure for either word-initial [b d g] or intervocalic [β ð γ].

A one-way between subjects ANOVA was conducted to compare the effect of speaker level (independent variable) on Spanish-speaking participants' mean discrimination accuracy. A main effect of speaker level was not found, F (3, 23) = 1.552, p = .228, η^2 = .168, suggesting that there are not significant differences in participants' discrimination of Spanish voiced stops and approximants. In terms of development in learners' perception of Spanish voiced stops and approximants between instruction levels, the results of the discrimination task show increases in learners' accuracy at different points in the curriculum. While there was an increase in learners' mean discrimination accuracy from the third- (43%) to the fourth-years (58%) of instruction, there was a decrease in mean discrimination accuracy from the first- (49%) to the third-years (43%) of instruction. In addition, there was a bigger increase in accuracy from the third- to the fourth-years of instruction than from the first- to the fourth-years of instruction. However, neither of these increases in accuracy nor the decrease in accuracy from the first- to the third-years of instruction were significant, as revealed by the results of the ANOVA.

The ANOVA performed on speaker level and Spanish-speaking participants' mean identification accuracy was borderline significant, F (3, 23) = 3.071, p < .048, η^2 = .286. However, post-hoc Tukey HSD tests revealed that only the difference between native speakers and first-year learners was approaching significance, p = .051. Native speakers' mean identification accuracy did not differ significantly from either third- (p =

.190) or fourth-year (p = .721) learners. Similarly, first-year learners' mean identification accuracy did not differ significantly from either third- (p = .746) or fourth-year (p = .182) learners. Finally, third- and fourth-year learners' mean identification accuracy did not differ significantly, p = .607. As reported in Chapter 5, although learner's identification accuracy increases from the first- to the fourth-years of instruction, the results of the ANOVA indicate that none of these increases are large enough to be significant.

Although differences between participants at different levels of instruction were not significant, as revealed by the production and perception ANOVAs and post-hoc testing, the results of the Spanish production and perception tasks nevertheless show that there is development across instruction levels, which confirms the second hypothesis. Based on the results of the Spanish production and perception tasks, it appears that the most development occurs between the first- and fourth-years of instruction and between the third- and fourth-years of instruction. An examination of the learners' background data may help explain this development. The age at which learners began studying Spanish decreases as instruction level increases such that first-year learners began studying Spanish on average at the age of 19.5, third-year learners began studying Spanish on average at the age of 13.2, and fourth-year learners began on average at the age of 11. It is not unexpected that the most development occurs between the first- and fourth-years of instruction since fourth-year learners began studying Spanish earliest in life and first-year learners began studying Spanish latest in life. In addition, years of L2 Spanish study completed increase as instruction level increases, with first-year learners who completed two years, third-year learners who completed 5.8 years, and fourth-year

learners who completed 9.8 years. Given that the biggest difference in years of L2 study completed is found between the first- and fourth-years of instruction, it is not surprising that development was found between these learners' production and perception.

Having discussed L2 Spanish learners' production and perception of voiced stops and approximants across instruction levels, we will now turn our attention to the Italian data to determine if there is a similar pattern of development. A one-way between subjects ANOVA was conducted to compare the effect of speaker level on the duration of vowels preceding Italian intervocalic voiced singleton stops. A main effect of speaker level was found, F (3, 21) = 4.435, $p < .015$, $\eta^2 = .388$, suggesting that there are significant differences in participants' mean vowel durations before singleton stops.[72] Post-hoc Tukey HSD tests revealed that native speakers produced vowels preceding singletons with significantly longer durations than first- ($p < .030$) and fourth-year learners ($p < .015$), but not than third-year learners ($p = .262$). Third- ($p = .703$) and fourth-year ($p = .942$) learners did not produce vowels preceding singletons with significantly longer durations than first-year learners, and fourth-year learners did not produce vowels preceding singletons with significantly longer durations than third-year learners ($p = .432$).

Speaker level did not have a main effect on the overall duration of intervocalic voiced singleton stops, F (3, 21) = .729, $p = .546$, $\eta^2 = .094$, suggesting that there are not significant differences between participants on this measure. In other words, no group of

[72] Citing Cohen (1988), Eddington (2015) states that "for ANOVA, partial eta^2 values around .01 show a weak effect, those around .06, a medium effect, and values of about .14 and larger, a large effect" (p. 66). Based on this, the value of .388 is a large effect size.

participants (native speakers or learners at any level of instruction) produced /b d g/ with significantly longer overall durations than other participants. Similarly, a main effect of speaker level was not found on closure duration of intervocalic voiced singleton stops, F (3, 21) = .552, p = .652, η^2 = .073, suggesting that there are not significant differences between participants on this measure. Finally, speaker level also did not have a main effect on the C/V ratio of intervocalic voiced singleton stops, F (3, 21) = 1.498, p = .244, η^2 = .176, suggesting that there are not significant differences between participants on this measure.

In summary, while the results of the production ANOVAs on intervocalic voiced singleton stops indicate that learners at higher levels of instruction (i.e., third and fourth year) do not make significantly greater gains than first-year learners on any measure, the descriptive statistics nevertheless indicate that there is development in L2 learners' production across instruction levels, which confirms the second hypothesis. For preceding vowel duration, there is development from the first- to the third-years of instruction. For overall stop duration, closure duration and C/V ratios, there is development across all levels of instruction, as they consistently increase from the first- to the third-years of instruction, from the third- to the fourth-years of instruction, and from the first- to the fourth-years of instruction.

Having discussed the results of the ANOVAs on Italian intervocalic voiced singleton stops, we will now turn our attention to the results of the ANOVAs on Italian intervocalic voiced geminate stops. A main effect of speaker level was found on the duration of vowels preceding geminate stops, F (3, 21) = 3.117, p < .048, η^2 = .308,

suggesting that there are significant differences between participants on this measure. Post-hoc Tukey HSD tests revealed that native speakers produced vowels preceding /b: d: g:/ with significantly shorter durations than third-year learners ($p < .044$), but not than first-year learners ($p = .098$) or fourth-year learners ($p = .483$). Third-year learners ($p = .930$) and fourth-year learners ($p = .774$) did not produce vowels preceding /b: d: g:/ with significantly shorter durations than first-year learners and fourth-year learners did not produce vowels preceding /b: d: g:/ with significantly shorter durations than third-year learners ($p = .478$).

Speaker level also had a main effect on the overall duration of intervocalic voiced geminate stops, F (3, 21) = 5.282, $p < .007$, $\eta^2 = .430$, suggesting that there are significant differences between participants on this measure. Post-hoc Tukey HSD tests revealed that native speakers produced /b: d: g:/ with significantly longer overall durations than first-year learners ($p < .004$), but not than third- ($p = .061$) and fourth-year learners ($p = .103$). Third- ($p = .664$) and fourth-year learners ($p = .484$) did not produce /b: d: g:/ with significantly longer overall durations than first-year learners and fourth-year learners did not produce /b: d: g:/ with significantly longer overall durations than third-year learners ($p = .992$).

A main effect of speaker level was found on closure duration of intervocalic voiced geminate stops, F (3, 21) = 4.878, $p < .010$, $\eta^2 = .411$, suggesting that there are significant differences between participants on this measure. Post-hoc Tukey HSD tests revealed that native speakers produced /b: d: g:/ with significantly longer closure durations than first-year learners ($p < .005$), but not than third- ($p = .085$) and fourth-year

learners (p = .118). Third- (p = .642) and fourth-year learners (p = .527) did not produce /b: d: g:/ with significantly longer closure durations than first-year learners and fourth-year learners did not produce /b: d: g:/ with significantly longer closure durations than third-year learners (p = .998).

Finally, speaker level had a main effect on the C/V ratio of intervocalic voiced geminate stops, F (3, 21) = 10.511, p < .000, η^2 = .600, suggesting that there are significant differences between participants on this measure. Post-hoc Tukey HSD tests revealed that native speakers expectedly produced /b: d: g:/ with significantly greater C/V ratios than first- (p < .000), third- (p < .002), and fourth-year learners (p < .009). However, third- (p = .722) and fourth-year (p = .308) learners did not produce /b: d: g:/ with significantly greater C/V ratios than first-year learners, and fourth-year learners did not produce /b: d: g:/ with significantly greater C/V ratios than third-year learners (p = .901).

In summary, while the results of the production ANOVAs on intervocalic voiced geminate stops indicate that learners at higher levels of instruction (i.e., third and fourth year) do not make significantly greater gains than first-year learners on any measure, the descriptive statistics nevertheless indicate that there is development in L2 learners' production across instruction levels, which confirms the second hypothesis. For preceding vowel duration, there is development from the first- to the fourth-years of instruction and from the third- to the fourth-years of instruction, as it decreases while it increases from the first- to the third-years of instruction. For overall stop duration, closure duration, and C/V ratios, there is development across all levels of instruction,

consistently increasing from the first- to the third-years of instruction, from the third- to the fourth-years of instruction, and from the first- to the fourth-years of instruction.

A one-way between subjects ANOVA was conducted to compare the effect of speaker level (independent variable) on Italian-speaking participants' mean discrimination accuracy. A main effect of speaker level was not found, F (3, 21) = 2.354, p = .101, η^2 = .252, suggesting that there are not significant differences in participants' discrimination of Italian voiced singleton and geminate stops. In terms of development in learners' perception of Italian voiced singleton and geminate stops between instruction levels, the results of the discrimination task, reported in Chapter 5, show consistent increases, albeit rather small, in learners' accuracy from the first- to the fourth-years of instruction. The largest increase in discrimination accuracy is from the first- to the fourth-years of instruction followed by the first- to the third-years of instruction. However, the results of the ANOVA revealed that these increases in accuracy were too small to reach significance.

The ANOVA performed on speaker level and Italian-speaking participants' mean identification accuracy revealed a main effect of speaker level, F (3, 21) = 4.474, p < .014, η^2 = .390, suggesting that there are significant differences in participants' identification accuracy of Italian voiced singleton and geminate stops. However, post-hoc Tukey HSD tests indicated that only the difference between native speakers and first-year learners was significant, p < .009. Native speakers' mean identification accuracy did not differ significantly from either third- (p = .074) or fourth-year (p = .064) learners. Similarly, first-year learners' mean identification accuracy did not differ significantly

from either third- (p = .832) or fourth-year (p = .870) learners. Finally, third- and fourth-year learners' mean identification accuracy did not differ significantly, p = 1.000. As reported in Chapter 5, although learner's identification accuracy increases from the first- to the third-years of instruction and decreases slightly from the third- to the fourth-years of instruction, the results of the ANOVA indicate that neither this increase nor decrease in accuracy is large enough to be significant.

Although differences between participants at different levels of instruction were not significant, as revealed by the production and perception ANOVAs and post-hoc testing, the results of the Italian production and perception tasks nevertheless show that there is development across instruction levels, which confirms the second hypothesis. Based on the results of the Italian production task, it appears that the most development occurs between the first- and fourth-years of instruction followed by the first- and third-years of instruction and the third- and fourth-years of instruction. Based on the results of the Italian perception tasks, it appears that the most development occurs between the first- and third-years of instruction and between the first- and fourth-years of instruction. An examination of the learners' background data may help explain this development. Years of L2 Italian study completed increase as instruction level increases, with first-year learners who completed half of one year, third-year learners who completed 2.8 years, and fourth-year learners who completed 3.6 years. Given that the biggest difference in years of L2 study completed is found between the first- and fourth-years of instruction, it is not surprising that the most development was found between these learners' production and perception. Time spent abroad similarly increases as instruction level increases, such

that first-year learners spent the least amount of time on average in Italy (one week), followed by third-year learners who spent on average 10.1 weeks in Italy, and fourth-year learners who spent on average 31.5 weeks in Italy. Since fourth-year learners spent considerably more time in Italy than first- and third-year learners, it is possible that this contributed to differences in development, as previous L2 Spanish studies have documented the benefit of extended stays abroad for L2 phonological acquisition (Alvord & Christiansen, 2012; Rogers & Alvord, 2014).

6.2.3 Research Question #3

The third research question asked whether learners' productive and perceptive abilities are related. The data, presented in Chapter 5, revealed that whether L2 Spanish learners' productive and perceptive abilities are related depends on their instruction level, as only third-year L2 Spanish learners' production and identification of target sounds were correlated. First- and fourth-year L2 Spanish learners' production and discrimination and production and identification of target sounds were not correlated. It can therefore be concluded that only the results of the Spanish correlation analysis for third-year learners' production and identification confirm the third hypothesis that L2 learners' productive and perceptive abilities are related.

González-Bueno and Quintana-Lara (2011) and Kissling (2013a) are the only previous studies, to the best of my knowledge, to examine L2 Spanish learners' production and perception of voiced approximants; however, given differences in study designs it is difficult to directly compare the results. González-Bueno and Quintana-Lara

reported similarity between production and perception accuracy of some target sounds, such as [β] and [γ], across learner levels, but did not compare production and perception accuracy through correlation analyses, so it is unknown if learners' productive and perceptive abilities were related. On the other hand, Kissling found a positive correlation between learners' production and perception for some target sounds, such as [ð]. Since no previous study, to the best of my knowledge, has investigated L2 Spanish learners' production and perception of both voiced stops and approximants through a correlation analysis and studies have only recently begun to correlate L2 Spanish learners' production and perception of voiced approximants, the results of the present correlation analyses should be interpreted with caution, as further studies are needed to make more definitive claims about the potential relationship between L2 Spanish learners' production and perception of voiced stops and approximants.

The Italian correlation data, presented in Chapter 5, similarly indicated that whether L2 learners' productive and perceptive abilities are related depends on their instruction level. First, all participants' production (measured as closure duration difference) and identification were correlated. Among the learner groups, only first-year learners' production (measured as closure duration difference) and identification were correlated. All participants' production (measured as overall duration difference) and identification were correlated. Among the Italian students, only first-year learners' production (measured as overall duration difference) and identification were correlated. In addition, only fourth-year learners' production (measured as preceding vowel duration difference) and discrimination were correlated. Finally, all participants' production

(measured as preceding vowel duration difference) and identification were correlated. It can be concluded that only the results of the Italian correlation analyses for first- and fourth-year learners' production and perception on certain measures confirm the third hypothesis that L2 learners' productive and perceptive abilities are related. De Clercq et al. (2014) is the only previous study, to the best of my knowledge, to investigate L2 Italian learners' production and perception of the singleton/geminate stop contrast, but they examined production and perception separately, so it is unknown if learners' productive and perceptive abilities were related. For this reason, the results of the present correlation analyses should be interpreted with caution, as further studies are needed to make more definitive claims about the potential relationship between L2 Italian learners' production and perception of singleton and geminate stops.

As stated in Chapter 1, one of the basic tenets of Flege's (1995) Speech Learning Model (SLM) is that L2 production and perception are related such that accurate perception of L2 sounds is a necessary precursor to accurate production of L2 sounds. The results of the present study support this claim, as the Spanish production and perception data and the Italian production and perception data were correlated on some but not all measures. As proposed in Section 6.2.1, if L2 Spanish learners' discrimination accuracy, prevoicing accuracy, and the frequency with which they produced target approximants as such are used to address the question of accuracy, then they are more accurate in perceiving rather than producing voiced stops and approximants, as their discrimination accuracy was higher than their prevoicing accuracy and approximant frequency across instruction levels, suggesting that perception precedes production. The

overall production and perception accuracy scores for the Italian data reported in Section 6.2.1 indicate that L2 Italian learners are more accurate in perceiving rather than producing voiced singleton and geminate stops across instruction levels, similarly suggesting that perception precedes production. It may therefore be concluded that L2 acquisition of the sounds associated with allophonic and phonemic contrasts in Spanish and Italian, respectively, proceeds similarly in the sense that receptive skills (perception) are acquired before productive skills (production).

In addition to the basic tenet of Flege's SLM, predictions were made in Chapter 1 based on the third, fifth, and seventh hypotheses of his model. Based on the third hypothesis of the SLM, it was predicted that differences in VOT between Spanish and English word-initial voiced stops will facilitate accurate perception of target Spanish voiced stops while the existence of similar, although infrequent voiced approximants in English and the subtle difference between Spanish voiced approximants and English voiced stops will not facilitate accurate perception of target Spanish voiced approximants. This prediction was confirmed, as learners across instruction levels struggled to discriminate Spanish voiced approximants from voiced stops. Based on the third hypothesis of the SLM, it was also predicted that the greater phonetic dissimilarity between Italian voiced geminate stops and English voiced stops than between Italian voiced singleton stops and English voiced stops will facilitate accurate perception of target Italian voiced geminate stops. The results of the Italian discrimination test appear to confirm this prediction, as accuracy was quite high, ranging from 75.7% to 79.7%, but the results of the Italian identification test do not appear to provide strong support for this

hypothesis, as accuracy was lower, ranging from 46.2% to 58.5%. Based on the SLM's fifth hypothesis, it was predicted that L2 Spanish learners will fail to establish separate phonetic categories for Spanish voiced stops and approximants if they are perceived as equivalent to English voiced stops. The results of the Spanish discrimination test, reported in Chapter 5, suggest that learners are in the process of establishing separate phonetic categories. Based on the SLM's fifth hypothesis, it was also predicted that L2 Italian learners will not establish separate phonetic categories for Italian voiced singleton and geminate stops if they are perceived as equivalent to English voiced stops. The results of the Italian perception task, especially the results of the discrimination test, reported in Chapter 5, similarly suggest that learners are in the process of establishing separate phonetic categories. Finally, based on the seventh hypothesis of the SLM, it was predicted that Spanish voiced approximants and Italian voiced geminate stops will not be produced in a target-like fashion if they are not perceived as approximants and geminates, respectively. The results of the acoustic analyses on the Spanish and Italian data, reported in Chapter 5, indicate that L2 Spanish learners struggled to produce voiced approximants in a target-like fashion and L2 Italian learners struggled to produce voiced geminate stops in a target-like fashion despite more accurate perception.

6.2.4 Research Question #4

The fourth and final research question asked whether L2 learners better perceive the Spanish allophonic or Italian phonemic contrast, while the hypothesis formulated based on this research question predicted that learners would better perceive the Italian

phonemic contrast than the Spanish allophonic contrast. L2 Spanish learners' overall mean discrimination accuracy was 50%, while their overall mean identification accuracy was 91%. In comparison, L2 Italian learners' overall mean discrimination accuracy was 78%, while their overall mean identification accuracy was 53.7%. These results suggest that on the discrimination test, L2 learners better perceive the phonemic contrast between Italian intervocalic voiced singleton and geminate stops, confirming the fourth hypothesis, while on the identification test, L2 learners better perceive the allophonic alternation between Spanish word-initial voiced stops and intervocalic voiced approximants. However, as mentioned in Section 6.2.1, since the written representation of voiced stops and approximants is the same in standard Spanish orthography, it may be argued that the results of the identification test do not really indicate whether learners do indeed perceive a difference between these sounds, and thus, the results of the discrimination test may be a better indicator of learners' perception of voiced stops and approximants. This is a limitation of the study that will be further discussed in Section 6.4.

Recall that since nonce words were used in the present study and all target words were presented to learners in isolation (i.e., they heard a word list reading), they could not rely on lexical familiarity or context to distinguish between target sound pairs on the perception task in their respective L2. Therefore, learners had to attentively focus on acoustic cues in the native speakers' pronunciation to discriminate between target sounds in each pair and correctly identify the difference between target sounds in each pair. The results of the present study suggest that on the discrimination test, at least, contrasts that

involve a variation in duration (a temporal cue) are better perceived by L2 learners than contrasts that involve a variation in manner of articulation perhaps because the Italian phonemic contrast involves an alteration in the production of both the consonant and preceding vowel, while the Spanish allophonic alternation only concerns a variation in the production of the consonant. This finding concurs with Lively, Pisoni, Yamada, Tohkura, and Yamada's (1994) finding that "contrasts that depend on spectral cues (e.g., level of closure in approximants) are more difficult to learn than temporal cues like voice onset timing" (p. 2076).

6.3 Conclusions and Contributions

The main research question that motivated the present study is whether allophonic or phonemic contrasts are acquired more easily by L2 learners of two different Romance languages (Spanish and Italian) from the same L1 background (American English). The results of the acoustic analyses on the Spanish and Italian production data do not appear to suggest that in production one of the target contrasts is acquired more easily by native English speakers than the other. As reported in Chapter 5, L2 Spanish learners from all three instruction levels produce word-initial voiced stops with voicing lead, which is encouraging because previous studies (González-Bueno, 1994; Zampini, 1998) have seldom found prevoicing in L2 Spanish learners' production of these sounds, but first- and third-year learners produce [b d g] with significantly less prevoicing than native speakers. In addition, when L2 Spanish learners produce target voiced approximants as such, their production is generally target-like, as indicated by the frequency with which

their mean intensity difference falls within the native speakers' range, as reported in Section 6.2.1. However, it is important to recall that L2 Spanish learners across instruction levels infrequently produce target approximants as such, just 23% to 41% of the time, and much more frequently produce these target sounds as stops, 59% to 73% of the time. As reported in Chapter 5, L2 Italian learners struggle to precisely implement the phonetic cues that distinguish geminate stops from their singleton counterparts, as learners generally lengthened rather than shortened the duration of vowels preceding geminates and they did not produce geminates with approximately double the duration of their singleton counterparts. Based on the results of the acoustic analyses, it may be concluded that L2 learners are still in the process of acquiring the allophonic alternation between Spanish voiced stops and approximants and the phonemic contrast between Italian intervocalic voiced singleton and geminate stops, and therefore, further studies are needed to make more definitive claims about which contrast is acquired more easily in production. On the other hand, as stated in the discussion of the fourth research question, the results of the Spanish and Italian discrimination tests suggest that the phonemic contrast in Italian is acquired more easily in perception than the allophonic alternation in Spanish.

Based on the results of this study, it may also be concluded that while learners are still in the process of acquiring the target sounds associated with allophonic and phonemic contrasts in their respective L2, there is development from the first- to the fourth-years of university study. Finally, given that L2 Spanish and L2 Italian learners' production and perception are moderately to strongly related on certain measures, it is

possible that learners' production difficulties have a perceptual basis, as L2 Spanish learners struggled to discriminate voiced approximants from voiced stops and L2 Italian learners struggled to identify the length difference between voiced singleton and geminate stops. This conclusion constitutes an important contribution of the present study because, as stated in Chapter 2, perception studies in general have lagged behind production studies on L2 acquisition of Spanish voiced stops and approximants and only two previous studies (González-Bueno & Quintana-Lara, 2011; Kissling, 2013a) have investigated L2 Spanish learners' production and perception of these sounds.[73] While many previous studies have documented L2 Spanish learners' difficulty in producing voiced stops and approximants in a native-like fashion (Díaz-Campos, 2004, 2006; Elliott, 1997; González-Bueno, 1994; Kissling, 2013a; Lord, 2010; Zampini, 1994, 1998), the role of perception as a basis for learners' production difficulty has been understudied and not well-understood. In addition, as stated in Chapter 3, perception studies have similarly lagged behind production studies on L2 acquisition of Italian stop consonants, with only one previous study (De Clercq et al., 2014) investigating both production and perception but separately rather than through a correlation analysis, so it is unknown if learners' productive and perceptive abilities are related. While previous studies (Celata & Costamagna, 2011; De Clercq et al., 2014; Kabak et al., 2011) have documented L2 Italian learners' difficulty in producing geminate stops in a target-like fashion, they have not considered the role of perception as a basis for learners' production difficulty.

[73] While both of these studies examined L2 Spanish learners' production and perception of Spanish voiced approximants, only Kissling (2013a) did so through a correlation analysis.

Another contribution of the present study is that it is one of few studies on L2 acquisition of Spanish word-initial voiced stops to document prevoicing in learners' production. It is particularly noteworthy that even first-year learners in the present study produced word-initial [b d g] with voicing lead of -16.86 ms on average since previous studies (González-Bueno, 1994; Zampini, 1998) have found that intermediate and advanced L2 Spanish learners, many of whom received explicit pronunciation instruction, rarely produce these sounds with voicing lead. The results of the present study suggest that it is possible for L2 Spanish learners to begin acquiring prevoicing of word-initial voiced stops as early as their first year of university study.[74]

This study also makes a valuable contribution to the L2 Italian phonological acquisition literature, as few studies have investigated L2 Italian learners' acquisition of the singleton/geminate stop contrast in general and by native English speakers in particular. In addition, since previous studies on L2 acquisition of the Italian singleton/geminate stop contrast (Celata & Costamagna, 2011; De Clercq et al., 2014; Kabak et al., 2011; Rochet & Rochet, 1995) have focused on university-level L2 learners from lower proficiency levels, it is unknown how learners' production and perception of these sounds develop over time. The present study begins to address this gap by examining acquisition in L2 learners at different points in a university curriculum. Finally, a more broad contribution of the present study is that cross-linguistically, this research sheds light on how acquisition of the most common sounds, stops, among the

[74] Since the first-year learners are a rather small group (n = 6), further studies are needed to make a more definitive claim about this finding.

world's languages unfolds in two different but historically related languages by L2 learners with a common first language.

6.4 Limitations

While the results of the present study make valuable contributions to the respective L2 Spanish and L2 Italian phonological acquisition literatures, it is important to acknowledge that our understanding of the present findings may be limited given the limited number of L2 Spanish and L2 Italian learners. In addition, even though moderate to strong correlations were found on some but not all measures, as previously stated, the results of the Spanish and Italian correlation analyses should be interpreted with caution, as further studies are needed to make more definitive claims about the potential relationship between L2 Spanish learners' production and perception of voiced stops and approximants and between L2 Italian learners' production and perception of singleton and geminate stops.

Our understanding of the present findings may also be limited by the way in which learners were grouped because although L2 Spanish and L2 Italian learners in their first-, third-, and fourth-years of university study differ in terms of the age when they first began studying their L2, years of L2 study completed, and time spent abroad, as reported in Chapter 4, these background data may not be considered objective measures of L2 experience, as they were self-reported on a language background questionnaire. In addition, the background data and the course in which learners were enrolled at the time of the study are not intended to be measures of L2 proficiency, but rather of L2

experience. However, a future study should use a proficiency measure, such as an oral proficiency interview (OPI), to group learners because it would more clearly show meaningful and objective differences between learner groups than level of instruction and self-reported background data. A proficiency measure would also help to better ensure more homogeneity among learners within groups, as learners of differing abilities are often enrolled in the same level language course.

While the present cross-sectional study provides a snapshot into L2 acquisition of Spanish voiced stops and approximants and into L2 acquisition of Italian voiced singleton and geminate stops at different points in a university curriculum, it may be argued that a longitudinal study that follows the same learners over an extended period of time may provide more insight into the question of development over time. However, given the time constraints on this project, such a study was not feasible and remains a topic ripe for future research. While previous studies on L2 acquisition of Spanish voiced approximants have investigated acquisition in advanced learners, such as graduating Spanish majors and Ph.D. students (Face & Menke, 2009), no previous study, to the best of my knowledge, has examined L2 acquisition of these sounds or of the Italian singleton/geminate stop contrast over an extended period of time.

As previously mentioned, another limitation of this study concerns one of the experimental tasks used to assess learners' perception. It can be argued that an identification test such as the one used in this study does not help to determine whether L2 Spanish learners do indeed perceive a difference between voiced stops and approximants because their written representation is the same in standard Spanish

orthography. Kissling (2013a) notes that "the experimental methods available for addressing acquisition of non-contrastive L2 phones [such as voiced approximants] are less than ideal" (p. 171). An identification test that involves phonetically transcribing words would be more helpful in assessing learners' perception of these sounds; however, such a task could only be employed in a study in which participants were enrolled in a Spanish phonetics/phonology course or had previously completed such a course, as learners enrolled in beginning, intermediate, and even advanced language courses at this particular university would not have knowledge of phonetic transcription. On the other hand, since the written representation of voiced singleton and geminate stops is different in standard Italian orthography, the Italian identification test can be considered a reliable indicator of learners' perception in addition to the discrimination test.

Because the Spanish discrimination test in the present study did not rely on learners' spelling of target sounds but rather on their ability to discern differences in the speech stream, it may be a better indicator of learners' perception of Spanish voiced stops and approximants. However, as previously stated, native Spanish speakers' lower discrimination accuracy than learners' discrimination accuracy is a limitation of this study because based on these results, learners should not be aiming toward native speaker performance. It is possible that the difference between native speakers and learners on the discrimination test lies in their interpretation of the instructions for this task. Perhaps, the native speakers interpreted the instructions in terms of phonology: determine whether the speaker produces the same sound, whereas learners have less well-formed phonological

models for this contrast and they based their decisions (same/different) on phonetic differences in the signal.

Finally, another limitation of the present study is the way in which the Italian words were presented to participants. For the Italian production task, many word pairs were presented to participants that differed only in terms of the parameter under investigation (i.e., singleton vs. geminate stop), providing them a clue as to the purpose of the experiment and encouraging them to produce some sort of distinction between the two words, if the two words differed orthographically. It is therefore likely that the focus on geminates was obvious to at least some participants.

6.5 Future Research

Given the contributions of the present study and despite the limitations addressed in the previous section, the results of this study suggest that this topic is ripe for further research. Recall that since nonce words were used in the present study and all target words were presented to learners in isolation (i.e., word list), they could not rely on lexical familiarity to aid in their pronunciation or draw on differences in meaning between target word pairs in Italian to distinguish between sounds in production and/or perception. It would be worthwhile for a future study to examine L2 acquisition of the allophonic alternation between Spanish voiced stops and approximants and of the phonemic contrast between Italian intervocalic voiced singleton and geminate stops using real words in each language that contain these target sounds in order to determine whether lexical familiarity would affect learners' acquisition. Previous studies on L2

acquisition of Spanish stress have found that lexical familiarity affects learners' production (Bullock & Lord, 2003; Lord, 2002, 2007). Since lexical familiarity has been found to affect L2 learners' production of a suprasegmental feature such as stress, it is certainly plausible that it could similarly affect their production and/or perception at a segmental level.

Another topic that warrants investigation in the future is whether differences observed acoustically in the learner data - such as significantly less prevoicing of Spanish word-initial [b d g], the high frequency of target Spanish voiced approximants produced as voiced stops, lengthening of vowels preceding Italian voiced geminate stops, and not sufficiently lengthening Italian voiced geminate stops - impact how native speakers perceive learner speech. While there is a long line of SLA research on foreign accent in general (cf. Flege, Munro, & MacKay, 1995; Munro, 1993; Munro & Derwing, 1994, 1995), perception of foreign accent by native speakers has not been widely studied in the L2 Spanish phonological acquisition literature on stops and approximants, as only one such study, to the best of my knowledge, by González-Bueno (1997b) – focusing on the voiceless velar stop /k/ - has been carried out, and it has not yet been examined in the L2 Italian phonological acquisition literature on singleton and geminate stops. González-Bueno found that English-accented productions of /k/, the result of long VOT and aspiration, noticeably affected native speakers' perception of the learners' productions. Given this finding and Kissling's (2013a) claim that "it remains an empirical question to what extent accuracy in production and perception of … L2 … segments impacts accent, comprehensibility, and/or intelligibility" (p. 172), future studies on L2 acquisition of

Spanish voiced stops and approximants and of Italian voiced singleton and geminate stops, as well as of other sounds, should investigate native speakers' perception of learner speech.

Finally, another topic that merits investigation in the future, as previously mentioned, is the question of development over time through a longitudinal study. In fact, Tarone (2007) calls for more longitudinal SLA studies, stating "we need more studies that track over an extended period of time the development of specific L2 forms in the speech of individual L2 learners" (p. 845). Longitudinal studies on L2 acquisition of Spanish word-initial voiced stops and intervocalic voiced approximants and of Italian intervocalic voiced singleton and geminate stops would make valuable contributions to the respective L2 Spanish and L2 Italian phonological acquisition literatures, documenting how learners' production and perception of target sounds develop over time and shedding light on whether allophonic or phonemic contrasts are acquired more easily by L2 learners.

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Appendix 1 Background Questionnaire for Spanish Learners

Please complete the following questionnaire. The information you provide will be kept confidential and used only for the purposes of the study. Please circle your answers to multiple-choice questions.

Age: _____ Gender: M / F

What city and state did you grow up in?
_____

Your class level (Freshman / Sophomore / Junior / Senior / Other)
If you answered "Other," please explain.
_____

Major 1 _____
Major 2 (if any) _____
Minor 1 (if any) _____
Minor 2 (if any) _____

Language Experience
1. Is your native language English? Yes / No
If you answered no, what is your native language(s)?_____
2. Are you of Hispanic and/or Spanish-speaking background? (Yes / No)
If you answered "Yes," please explain.
_____
3. Approximately how old were you when you first began studying Spanish? _____

4. What Spanish courses did you take *before college*? For each course, please list the course name and number, how old you were, and (to your knowledge) if your instructor was a native speaker of Spanish or not?
Course name/number _____ Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name /number_____Age __ Native Speaker? (Yes/No/Not Sure)

5. What *college level* courses have you taken? For each course, please describe how many hours per week you were in class, and (to your knowledge) if your instructor was a native speaker of Spanish or not.
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?

(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)

6. What Spanish courses are you currently taking this semester? For each course, please describe how many hours per week you are in class, and (to your knowledge) if your instructor is a native speaker of Spanish or not.
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)

7. For how many years did you study Spanish at each of the following levels?
Elementary School _____
Middle School_____
High School_____
University_____

8. Have you had any instruction in Spanish sounds or Spanish pronunciation – for instance, with a language teacher, private tutor, or computer program? If so, please describe the instruction.

9. On a scale of 1 (easiest) to 4 (hardest), how difficult do you find each of the following areas of Spanish?
Pronunciation _____
Grammar _____
Vocabulary _____

10. Do you use Spanish outside the classroom? For instance, do you watch Spanish TV or movies or speak Spanish with family, friends, or coworkers? Please briefly describe what you do, in terms of when you use Spanish, how often, with whom, for what purposes, etc.

Activity	Frequency in Hours per Week
Watch Spanish TV/movies	0 1 2 3 4 5 6 7 8 9 10
Listen to Spanish music	0 1 2 3 4 5 6 7 8 9 10
Speak Spanish with family	0 1 2 3 4 5 6 7 8 9 10
Speak Spanish with friends	0 1 2 3 4 5 6 7 8 9 10
Speak Spanish with coworkers	0 1 2 3 4 5 6 7 8 9 10
Other (explain): _____	0 1 2 3 4 5 6 7 8 9 10
Other (explain): _____	0 1 2 3 4 5 6 7 8 9 10

11. Have you traveled to or lived in a Spanish-speaking country? If so, which country? Why? For how long? How did you use Spanish while you were there?

Country _____ Length of stay _____

Purpose of travel

_____

Use of Spanish

_____

Country _____ Length of stay _____

Purpose of travel

_____

Use of Spanish

_____

12. Have you studied any languages *other than Spanish*? If so, please describe for each which classes you have taken, how old you were, and how many hours per week you were in class.

Language _____

Course name/number _____Class hrs/wk ___ Age __

Course name/number _____Class hrs/wk ___ Age __

Course name/number _____Class hrs/wk ___ Age __

Language _____

Course name/number _____Class hrs/wk ___ Age __

Course name/number _____Class hrs/wk ___ Age __
Course name/number _____Class hrs/wk ___ Age __

13. Do you use a language other than Spanish or English outside the classroom? For instance, do you watch TV or movies in this language or speak the language with coworkers or friends? Please briefly describe what you do, in terms of when you use the language, how often, with whom, for what purposes, etc.
Language _____
_____
_____
_____
Language _____
_____
_____
_____

14. Do you have any other language experience that you haven't mentioned so far? If so, please explain.
_____

Thank you for completing the questionnaire. The information you provided will be kept confidential and used only for the purposes of the study.

Appendix 2 Background Questionnaire for Italian Learners

Please complete the following questionnaire. The information you provide will be kept confidential and used only for the purposes of the study. Please circle your answers to multiple-choice questions.

Age: _____ Gender: M / F

What city and state did you grow up in?
_____

Your class level (Freshman / Sophomore / Junior / Senior / Other)
If you answered "Other," please explain.
_____

Major 1 _____
Major 2 (if any) _____
Minor 1 (if any) _____
Minor 2 (if any) _____

Language Experience
1. Is your native language English? Yes / No
If you answered no, what is your native language(s)?_____
2. Are you of Italian background? (Yes / No)
If you answered "Yes," please explain.
_____
3. Approximately how old were you when you first began studying Italian? _____

4. What Italian courses did you take *before college*? For each course, please list the course name and number, how old you were, and (to your knowledge) if your instructor was a native speaker of Italian or not?
Course name/number _____ Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Age __ Native Speaker? (Yes/No/Not Sure)
Course name /number_____Age __ Native Speaker? (Yes/No/Not Sure)

5. What *college level* courses have you taken? For each course, please describe how many hours per week you were in class, and (to your knowledge) if your instructor was a native speaker of Italian or not.
Course name/number _____Class hrs/wk __ Native Speaker? (Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?

(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)

6. What Italian courses are you currently taking this semester? For each course, please describe how many hours per week you are in class, and (to your knowledge) if your instructor is a native speaker of Italian or not.
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)
Course name/number _____Class hrs/wk __ Native Speaker?
(Yes/No/Not Sure)

7. For how many years did you study Italian at each of the following levels?
Elementary School _____
Middle School_____
High School_____
University_____

8. Have you had any instruction in Italian sounds or Italian pronunciation – for instance, with a language teacher, private tutor, or computer program? If so, please describe the instruction.

9. On a scale of 1 (easiest) to 4 (hardest), how difficult do you find each of the following areas of Italian?
Pronunciation _____
Grammar _____
Vocabulary _____

10. Do you use Italian outside the classroom? For instance, do you watch Italian TV or movies or speak Italian with family, friends, or coworkers? Please briefly describe what you do, in terms of when you use Italian, how often, with whom, for what purposes, etc.

Activity	Frequency in Hours per Week
Watch Italian TV/movies	0 1 2 3 4 5 6 7 8 9 10
Listen to Italian music	0 1 2 3 4 5 6 7 8 9 10
Speak Italian with family	0 1 2 3 4 5 6 7 8 9 10
Speak Italian with friends	0 1 2 3 4 5 6 7 8 9 10
Speak Italian with coworkers	0 1 2 3 4 5 6 7 8 9 10
Other (explain): _____	0 1 2 3 4 5 6 7 8 9 10
Other (explain): _____	0 1 2 3 4 5 6 7 8 9 10

11. Have you traveled to or lived in Italy? If so, why? For how long? How did you use Italian while you were there?
Length of stay _____
Purpose of travel
_____
Use of Italian
_____

12. Have you studied any languages *other than Italian*? If so, please describe for each which classes you have taken, how old you were, and how many hours per week you were in class.
Language _____
Course name/number _____Class hrs/wk ___ Age __
Course name/number _____Class hrs/wk ___ Age __
Course name/number _____Class hrs/wk ___ Age __

Language _____
Course name/number _____Class hrs/wk ___ Age __
Course name/number _____Class hrs/wk ___ Age __
Course name/number _____Class hrs/wk ___ Age __

13. Do you use a language other than Italian or English outside the classroom? For instance, do you watch TV or movies in this language or speak the language with coworkers or friends? Please briefly describe what you do, in terms of when you use the language, how often, with whom, for what purposes, etc.
Language _____

_____
_____
_____
Language _____
_____
_____
_____

14. Do you have any other language experience that you haven't mentioned so far? If so, please explain.
_____

Thank you for completing the questionnaire. The information you provided will be kept confidential and used only for the purposes of the study.

Appendix 3 Background Questionnaire for Native Spanish Speakers

Please complete the following questionnaire. The information you provide will be kept confidential and used only for the purposes of the study. Please circle your answers to multiple-choice questions.

Age: _____ Gender: M / F Current occupation:
_____

Language Experience
1. Where were you born? Country: _____ City: _____
2. Where have you lived other than your place of birth? Please explain where, when, and for how long.
_____
_____
_____

3. Did you hear and use only Spanish between the ages of 0 – 5? Yes / No
If you answered 'No,' please explain.
_____
_____

4. What other languages do you know? Please explain how old you were when you started learning or using each language, how you used it (e.g., in school, with friends, etc.), the total amount of time or experience you have with it, and about how proficient you currently are in it.
a. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
b. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
c. Language: _____
Age: _____
How I learned/used it:
_____

Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
d. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced

5. Do you have any other language experience that you haven't mentioned so far? If so, please explain.
_____
_____

6. Have you ever taken a class in, or otherwise received training in, phonetics or phonology? Yes / No
If yes, please explain.
_____

7. What is the highest level of education you have completed? Where did you complete your education?
_____

8. What area(s) is/are your degree(s) in?
_____

Thank you for completing the questionnaire. The information you provided will be kept confidential and used only for the purposes of the study.

Appendix 4 Background Questionnaire for Native Italian Speakers

Please complete the following questionnaire. The information you provide will be kept confidential and used only for the purposes of the study. Please circle your answers to multiple-choice questions.

Age: _____ Gender: M / F Current occupation:
_____

Language Experience
1. Where were you born? Region: _____ City: _____
2. Where have you lived other than your place of birth? Please explain where, when, and for how long.
_____
_____
_____

3. Did you hear and use only Italian between the ages of 0 – 5? Yes / No
If you answered 'No,' please explain.
_____
_____

4. What other languages do you know? Please explain how old you were when you started learning or using each language, how you used it (e.g., in school, with friends, etc.), the total amount of time or experience you have with it, and about how proficient you currently are in it.
a. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
b. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
c. Language: _____
Age: _____
How I learned/used it:
_____

Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced
d. Language: _____
Age: _____
How I learned/used it:
_____
Years experience: _____
Estimated proficiency level: novice / low intermediate / high intermediate / advanced / very advanced

5. Do you have any other language experience that you haven't mentioned so far? If so, please explain.
_____
_____

6. Have you ever taken a class in, or otherwise received training in, phonetics or phonology? Yes / No
If yes, please explain.
_____

7. What is the highest level of education you have completed? Where did you complete your education?
_____

8. What area(s) is/are your degree(s) in?
_____

Thank you for completing the questionnaire. The information you provided will be kept confidential and used only for the purposes of the study.

Appendix 5 Spanish Word List

1. Gogu
2. Bebina
3. Nenada
4. Chechu
5. Pepo
6. Gagu
7. Dadu
8. Papen
9. Didoso
10. Preposa
11. Nenato
12. Refunfusa
13. Bobe
14. Goruga
15. Bobi
16. Daducir
17. Bibo
18. Trita
19. Gugu
20. Treto
21. Memiso
22. Dedoso
23. Cachón
24. Pepato
25. Caqueta
26. Gugo
27. Dido
28. Copaco
29. Lepal
30. Fufe
31. Lecal
32. Capaco
33. Bube
34. Nonuco
35. Biba
36. Tetor
37. Gogo
38. Compuco
39. Muma
40. Titera
41. Bubu
42. Pripesa

43. Dade
44. Dode
45. Sustre
46. Sesar
47. Biboso
48. Cantaco
49. Gatego
50. Dudi
51. Cinasa
52. Babo
53. Dedi
54. Sosta
55. Goriga
56. Rarota
57. Mastito
58. Goga
59. Tator
60. Copica
61. Babeda
62. Naneco
63. Nuna
64. Gogua
65. Tometo
66. Tutila
67. Memer
68. Gogaso
69. Dadicar
70. Titela
71. Pepeto
72. Pechacha
73. Lala
74. Tecaco
75. Pipato
76. Sistre
77. Dida
78. Tatara
79. Fefa
80. Tetal
81. Titubo
82. Copeca
83. Gagua
84. Deda
85. Sesmo
86. Papeto

87. Babuso
88. Farfula
89. Babe
90. Babu
91. Nineco
92. Guga
93. Gugua
94. Tital
95. Gaguso
96. Diducir
97. Dudu
98. Popato
99. Bibear
100. Bibe
101. Cocao
102. Mumar
103. Dadi
104. Popila
105. Popela

Appendix 6 Italian Word List

1.	Tefa	Tefa
2.	Mopo	Moppo
3.	Ghiando	Ghiando
4.	Lado	Laddo
5.	Raspoto	Raspoto
6.	Repo	Reppo
7.	Gona	Gona
8.	Riba	Ribba
9.	Ruvena	Ruvena
10.	Lude	Ludde
11.	Sambeca	Sambeca
12.	Mabo	Mabbo
13.	Lova	Lova
14.	Ligo	Liggo
15.	Misa	Misa
16.	Maca	Macca
17.	Cilo	Cilo
18.	Bagio	Bagio
19.	Raco	Racco
20.	Sifa	Sifa
21.	Faca	Facca
22.	Livagna	Livagna
23.	Seba	Sebba
24.	Biva	Biva
25.	Vempa	Vempa
26.	Dego	Deggo
27.	Ciulo	Ciulo
28.	Bego	Beggo
29.	Zurolo	Zurolo
30.	Inculino	Inculino
31.	Fapa	Fappa
32.	Sovano	Sovano
33.	Sapa	Sappa
34.	Feva	Feva
35.	Gada	Gadda
36.	Dema	Dema
37.	Fego	Feggo
38.	Rava	Rava
39.	Ceta	Cetta
40.	Fista	Fista
41.	Fana	Fana
42.	Bade	Badde

43.	Biami	Biami
44.	Meco	Mecco
45.	Savolo	Savolo
46.	Rolo	Rolo
47.	Ropo	Roppo
48.	Mefa	Mefa
49.	Megna	Megna
50.	Sude	Sudde
51.	Tusa	Tusa
52.	Zorpo	Zorpo
53.	Zote	Zotte
54.	Gando	Gando
55.	Raca	Racca
56.	Burba	Burba
57.	Cesputo	Cesputo
58.	Cuda	Cudda
59.	Vescio	Vescio
60.	Gapa	Gappa
61.	Rufa	Rufa
62.	Cepa	Ceppa
63.	Tone	Tone
64.	Lifo	Lifo
65.	Duto	Dutto
66.	Rina	Rina
67.	Murba	Murba
68.	Nibo	Nibbo
69.	Siru	Siru
70.	Chiuva	Chiuva
71.	Nugo	Nuggo
72.	Nava	Nava
73.	Sema	Sema
74.	Laba	Labba
75.	Rigna	Rigna
76.	Biti	Bitti
77.	Festero	Festero
78.	Lida	Lidda
79.	Sfirza	Sfirza
80.	Neco	Necco
81.	Nuvera	Nuvera
82.	Bigo	Biggo
83.	Bicio	Bicio
84.	Zoto	Zotto
85.	Norchia	Norchia
86.	Bico	Bicco

87.	Bafo	Bafo
88.	Pego	Peggo
89.	Zagna	Zagna
90.	Gete	Gette
91.	Vura	Vura
92.	Feco	Fecco
93.	Senolare	Senolare
94.	Daba	Dabba
95.	Cogna	Cogna
96.	Nado	Naddo
97.	Vema	Vema
98.	Fapo	Fappo
99.	Bura	Bura
100.	Tigo	Tiggo
101.	Zeco	Zecco
102.	Fagio	Fagio
103.	Lube	Lubbe
104.	Nafo	Nafo
105.	Mugo	Muggo
106.	Chierini	Chierini
107.	Nara	Nara
108.	Sigo	Siggo
109.	Dimo	Dimo
110.	Nita	Nitta
111.	Selo	Selo
112.	Cabo	Cabbo
113.	Chieri	Chieri
114.	Niti	Nitti
115.	Vama	Vama
116.	Mada	Madda
117.	Brevo	Brevo
118.	Padi	Paddi
119.	Fiuro	Fiuro
120.	Sato	Satto
121.	Foscavi	Foscavi
122.	Chima	Chima
123.	Tupe	Tuppe
124.	Rusca	Rusca
125.	Daco	Dacco
126.	Valema	Valema
127.	Lita	Litta
128.	Nulino	Nulino
129.	Fibo	Fibbo
130.	Lovo	Lovo

131.	Fiba	Fibba
132.	Lice	Lice
133.	Maccia	Maccia
134.	Gagno	Gagno
135.	Tepo	Teppo
136.	Zampare	Zampare
137.	Nola	Nola
138.	Zafi	Zafi
139.	Gerafa	Gerafa
140.	Pinerola	Pinerola