January 1, 2015

The effect of short-term study abroad on second language Spanish phonetic development

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DOI 10.1515/shll-2015-0010

Abstract: This study explores the impact of study abroad (SA) on second language Spanish phonetic development. Twenty-seven English-speaking learners of Spanish, 15 who were participating in a 4-week SA program in the Dominican Republic and 12 who were studying at their home (AH) institution, were recorded 5 weeks apart (at the approximate beginning and end of their respective programs). Recordings were analyzed acoustically, and four groups of segments were examined: word-initial /p t k/, intervocalic /b d g/, intervocalic /r/ and /r/, and word-final /l/. Productions at Time 1 and Time 2 as well as between the SA and AH groups were compared. Results suggested a minor benefit of the SA environment for phonetic development of some of the segments but with notable individual variation in both groups.

Keywords: second language acquisition, study abroad, phonetic development

1 Introduction

As pointed out by Sanz (2014: 1) in a recent volume examining second language (L2) acquisition in study abroad (SA) contexts, “SLA researchers, practitioners, and of course language learners going abroad and their parents have always assumed that Study Abroad provides the best conditions for language development.” This assumption, arguably, has motivated much of the research examining the differential effects of the context of learning on the acquisition of various aspects of the L2 system, including grammar, vocabulary, pragmatics, fluency, and pronunciation (Freed 1998). Additionally, studies investigating the impact of a stay abroad on L2 receptive and productive abilities are of interest in the field

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of second language acquisition (SLA) because they facilitate the discussion surrounding the interaction between aspects of the external environment and rate or ultimate attainment in learning a L2 (Sanz 2014: 1).

With regard to L2 learning in the United States, it is not surprising that the semester or summer abroad has come to be seen as an important (albeit ancillary) component of language study. Recent statistics show that, although semester-long programs have remained fairly popular in the past decade (steadily accounting for approximately 40% of program choices for all students who study abroad nationwide), it is actually the short-term and summer programs that have experienced notable growth, with 53.4% of all U.S. students studying abroad during the 2005–2006 academic year choosing a short-term or summer program and 58.2% doing so in 2010–2011 (Indiana University Office of the Vice President for International Affairs 2014: 49). The growth in popularity of short-term and summer programs is also present within the specific institutional context of the present study: 41.8% of all students studying abroad during the 2005–2006 period participated in a short-term or summer program, a number that grew to 53.7% during the 2010–2011 period (Indiana University Office of the Vice President for International Affairs 2014: 50). This point raises the question of whether the often assumed benefits for language development of study abroad hold for these shorter term programs that are growing in popularity, and it signals the need for more studies that uncover the linguistic gains observed, if any, during short-term and/or summer study abroad.

The present study reports on an investigation examining the impact of a short stay abroad on L2 Spanish learners' phonetic development. Previous research investigating the impact of a stay abroad on L2 linguistic development has largely focused on morphosyntax (e.g., Collentine 2004; Segalowitz et al. 2004), pragmatic competence (e.g., Cohen and Shively 2007), and fluency (e.g., Freed et al. 2004; O'Brien et al. 2007; Segalowitz and Freed 2004). Findings in those areas have reported generally positive benefits of the SA setting on development in the L2 (cf. Collentine 2009). The potential impact of SA on L2 phonetic and phonological development, in contrast, is still not fully understood. Studies in this vein report modest and inconsistent gains for SA learners as compared to learners studying in the at-home (AH) setting (e.g., Crane 2011; Díaz-Campos 2004, 2006; Díaz-Campos and Lazar 2003; Lord 2010; Stevens 2011). Further, research to date has focused on a small subset of segments and on SA programs of 8 weeks or longer. The purpose of this study is to build upon previous literature that examines the role of context of learning on L2 phonetic and phonological development by expanding the range of sounds previously investigated, using acoustic analyses and characterizations to account for L2 phonetic development both abroad and at home (particularly for those segments

for which, previously, acoustic analyses were not employed), and exploring the impact of a short-term (i.e., in this case, 4-week) stay abroad.

We examined the development of four sets of Spanish segments by English-speaking learners over a 5-week period; the segments investigated were (a) word-initial /p t k/; (b) word-medial, intervocalic /b d g/; (c) word-medial, intervocalic /r/ and /r̄/; and (d) word-final /l/. These segments were selected for analysis both to offer an overview of L2 Spanish phonetic development by U.S. classroom learners¹ and because these sets of segments are frequently highlighted in textbooks of Spanish pronunciation aimed at English native speakers, especially due to their relationship to sounds in English speakers' native language phonology and their role in foreign accentedness (e.g., Morgan 2010; Quilis and Fernández 1979; Schwegler et al. 2010). Previous research investigating Spanish L2 phonetic and phonological development has addressed each of these segments to some extent (e.g., Díaz-Campos 2004; Zampini 1998 for /p t k/; Díaz-Campos 2004; Face and Menke 2009 for /b d g/; Face 2006 for rhotic segments; Díaz-Campos 2004 for /l/), laying the groundwork for examining all four sets of segments in one study and using acoustic analyses to investigate the impact of SA on L2 phonetic development.

The English-speaking learners that participated in this study comprised two groups: one participating in a short-term SA program and another studying in an AH context. In the following section, we provide an overview of what is known about the L2 acquisition of Spanish phonology by first language (L1) English-speaking learners and the role of the context of learning on L2 Spanish phonetic and phonological acquisition. We also provide a brief overview of the Spanish particular to the region in which the present SA program takes place.

2 Background

2.1 L2 Spanish phonetic and phonological acquisition

The voiceless stops /p t k/, especially with regard to voice onset time (VOT), have received considerable attention in previous literature investigating the

¹ As pointed out by an anonymous reviewer, investigating only consonantal segments does not provide a robust “overview” of phonetic acquisition. Nevertheless, given limitations of space and the different background research and methodology required for an analysis of vocalic acquisition, we elected to present consonantal and vocalic acquisition in two separate papers. More information regarding vocalic acquisition of these same learners was presented in Long et al. (2014).

Table 1: Average VOT values in milliseconds (ms) reported for /p t k/ in English and two dialects of Spanish.

Segment	American English (ms) (Lisker and Abramson 1964)	Puerto Rican Spanish (ms) (Lisker and Abramson 1964)	Castilian (Madrid) Spanish (ms) (Rosner et al. 2000)
/p/	58	4	16
/t/	70	9	14
/k/	80	16	26

Note: To the best of our knowledge, no empirical data exists on VOT values of native Dominican Spanish. Nevertheless, by including data from two varieties of Spanish, including a Caribbean dialect, we hope to show that American English VOT values are much greater than native Spanish VOT values regardless of dialect.

development of L2 Spanish speech production, particularly by L1 English-speaking learners (see Zampini 2013, for an overview). Measurements of VOT, or the time between the burst at the release of the occlusion and the onset of voicing of the following vowel, differ substantially between English and Spanish (see Table 1). The task of English-speaking learners of L2 Spanish is to move toward native Spanish norms by reducing VOT values (Zampini 2013). Several studies have shown that learners do reduce VOT values over time or as proficiency level increases (e.g., Zampini 1998; Zampini and Green 2001); however, the reduced VOT values demonstrated by learners are typically intermediate values in that they are longer than nativelike Spanish values but shorter than L1 English values. Previous research has also demonstrated that instruction can have a positive impact on the production of these segments (e.g., González-Bueno 1997; González-López and Counselman 2013; Lord 2005).

Less is known about development of the Spanish approximants [β ð ɣ], although research on these segments is growing. The first studies, based on error analysis (e.g., González-Bueno 1995, 1997; Shively 2008; Zampini 1994), showed that learners’ rates of spirantization (i.e., /b d g/ > [β ð ɣ]) were very low overall, even at advanced levels (e.g., below 20% for advanced level learners in Zampini 1994). Shively’s (2008) study in particular highlighted that greater accuracy in the production of these allophones was related to earlier age of exposure to Spanish, quality and quantity of interaction in Spanish outside of the classroom (including time spent abroad), and level of classroom instruction. In a more recent study, Face and Menke (2009) found that their 53 English-speaking learners of Spanish (fourth semester, graduating majors, and Ph.D. students) demonstrated increasing rates of spirantization as level increased, such that the most advanced learners spirantized at a fairly high rate (80%).

Nevertheless, the production of stops (particularly in stressed syllables) persisted in the speech of the graduating majors learner group.

The investigation of Spanish rhotic development is relatively recent, although it has long been a focus of pedagogical intervention (e.g., Elliott 1995). The production of Spanish rhotics poses a unique set of challenges to the English-speaking learner. First, the trill phoneme /r/ does not exist in American English and, due to its articulatory and aerodynamic complexity, appears to be difficult for learners to produce (Whitley 2002). The tap exists as an allophone of /t/ and /d/ in English, yet it is a rhotic phoneme, /ɾ/, in Spanish. Face (2006) examined the production of /ɾ/ and /r/ in intervocalic position by 41 English-speaking learners enrolled in either a fourth semester Spanish language course or an upper division Spanish elective course. In terms of accuracy, Face found that all learners' performance was better for the tap than the trill and that the learners enrolled in the upper division course performed better than the fourth-semester learners. Notably, Face offered a characterization of nontarget productions, which included productions such as approximants, nonnative tap-like segments, trills with one occlusion, and laterals. The production of these nontarget realizations was greater in number and variety for target trills than target taps.

To date very little is known about the development of lateral (i.e., *l*-like) segments by L2 learners of Spanish. Although /l/ exists as a phoneme in both English and Spanish, the acoustic and articulatory differences in the production of this segment across these languages can contribute to notably accented speech in the Spanish of L1 English speakers. Specifically, English /l/ productions are considerably "darker" or more velarized than Spanish /l/ and also tend to differ in relative darkness according to syllable position, with "clearer" or "lighter" /l/s occurring in syllable-initial position and darker /l/s occurring in syllable-final position. In most dialects of Spanish, in contrast, all /l/ realizations are considered to be clear or light (Whitley 2002: 59). What we do know about L2 Spanish acquisition of laterals thus far comes from the work of Solon (2012), who, in a study conducted on 29 L1 English-speaking learners of Spanish enrolled in three different course levels (beginner, intermediate low, and intermediate high), found that learners' productions of /l/ indeed moved in the direction of the nativelike norm over time in that they became less velarized as course level increased. Solon (2012) used second formant (F2) frequency measures as a proxy for degree of velarization (cf. Recasens 2004). In this way, "darkness" was quantified along a continuum, and /l/ production was submitted to an acoustic rather than an impressionistic analysis. A similar method was adopted for the analysis of laterals in the present study.

2.2 Context of learning and L2 Spanish phonological acquisition

In their comprehensive review of SA and L2 Spanish, Lafford and Uscinski (2014) briefly summarize recent work on the effects of SA on pronunciation and oral production abilities more generally.² Work in this area has included studies of the impact of SA on segmental acquisition both for consonants (e.g., Díaz-Campos 2004, 2006; Lord 2010; among others reviewed in more detail later in this section) and vowels (e.g., Simões 1996; Stevens 2011) as well as studies on the impact of learning context and SA on intonation (e.g., Henriksen et al. 2010) and phonological memory (e.g., Lord 2006; O'Brien et al. 2007). Interesting work on the acquisition of dialectal features during SA (e.g., awareness and use of [θ]) has also begun to appear in recent years (e.g., Knouse 2012; Ringer-Hilfinger 2012). In general, this body of research points to positive, albeit slight and inconsistent, benefits of SA for the acquisition of Spanish L2 phonetics and phonology. In keeping with the research objectives of the present study, we provide a closer look at those studies that have examined the segments of interest in the present study and their relationship to SA.

Existing research examining the impact of context of learning on the acquisition of the segments under study has produced mixed findings (with the exception of the rhotic segments, which have not yet received empirical attention). Díaz-Campos (2004, 2006), for instance, investigated development in the production of word-initial voiceless stops. Of the 46 English-speaking learners of Spanish who participated in his study, those studying in the AH setting ($n = 20$) showed similar gains to those studying abroad in Alicante, Spain ($n = 26$) after 10 weeks. Although his studies employed impressionistic analyses, a slightly earlier analysis (i.e., Díaz-Campos and Lazar 2003) conducted on the same groups of learners showed that the AH learners produced stops with lower VOT values than the SA learners at the end of the semester. Díaz-Campos and Lazar attributed these findings to greater length of previous formal instruction for the AH learners as well as greater self-reported use of Spanish outside of the classroom. Crane (2011) also reported that use of Spanish (overseas and after SA) predicted lower VOT

² Although this review focuses specifically on context of learning studies that deal with Spanish phonetics and phonology, it should be noted that a body of literature including other L1s and target languages (e.g., Avello and Lara 2014, for Spanish/Catalan learners of English; Regan et al. 2009, for Irish learners of French, to name two) also exists.

values for her participants, who were 20 missionaries who stayed in their respective countries of service for nearly 2 years. Other variables correlating with shorter or more targetlike VOT values in Crane's study included years of prior formal instruction and speech style. Although Crane's study lacked an AH control group, alongside the other studies reviewed here, her findings provide evidence that time abroad may facilitate gains in phonetic development. Nevertheless, the overall impact of context of learning on the phonetic development of these segments remains unclear.

More recently, SA research has focused on development of the approximant allophones of /b d g/. Díaz-Campos (2004, 2006) examined accuracy (impressionistically) in the production of intervocalic /b d g/ and showed that neither the SA nor the AH learner groups demonstrated gains toward greater rates of approximant or spirantized as opposed to stoplike realizations. Lord (2010) showed that instruction alongside immersion in the target language setting facilitated development of /b d g/ by English-speaking learners. Half of her learner participants ($n = 4$, $N = 8$ total), all of whom were participating in an intensive 8-week immersion program in Mexico, had previously received explicit instruction and practice on the stop ([b d g]) and spirantized ([β ð ɣ]) allophones of /b d g/ before traveling, whereas half had received no prior instruction. Lord reported that the combination of previous instruction and immersion created the best environment for gains in accurate production of the spirantized allophones, as a difference was observed between the instruction and no-instruction learner groups (i.e., a 20.1% gain as compared to a 2.8% gain, respectively). However, overall, all learners increased their production accuracy of these allophones after the 8-week experience abroad. Similar findings were reported by Alvord and Christiansen (2012), who found that 34 male missionaries who had spent 2 years abroad in a Spanish-speaking country demonstrated fairly high rates of spirantization of intervocalic /b d g/ (all around 80%) shortly after their return. It is important to note that although participants in these last two studies demonstrated gains during or after SA, no AH comparison groups were employed. Thus, the impact of the SA setting remains uncertain.

The last two groups of segments under study in the present paper have received the least attention thus far in previous context of learning research. Díaz-Campos (2004, 2006) provides the only studies that have examined the production of word-final /l/ by English-speaking learners. Using impressionistic analyses, he showed that (a) both the AH and the SA groups improved in /l/ production accuracy (i.e., producing a nonvelarized variant) and (b) the AH group favored production of the targetlike alveolar variant ([l]) slightly more than the SA group after the 10-week study period. With regard

to intervocalic /r/ and /r/, no studies to date have examined the potential impact of context of learning on their acquisition.

2.3 Dominican Spanish

The Spanish spoken in the Dominican Republic, the location of the SA program under investigation in this study, has been characterized as innovative and radical due to patterns of reduction in the consonantal system, most notably the /s/ in coda position (Alba 2004; Bullock and Toribio 2009; Jiménez Sabater 1975). With regard to the phones under investigation in the current study, considerable reduction of /d/ in intervocalic and word final position has been noted (Alba 1990, 2004), although we are not aware of any study that examines the reduction of /b/ or /g/. Additionally, Dominican liquids (i.e., rhotic and lateral phones), especially those of the Cibao dialect (which pertains to the region of the Dominican Republic in which the SA learners resided and studied), have been reported to be realized as allophonic variants, which pattern differently than in other dialects of Spanish, or at times to neutralize. These variants include reduced and often elided intervocalic taps (Willis and Bradley 2008), intervocalic trill variants produced with an initial portion of prebreathy voice followed by a single tap or trill (Willis 2006, 2007), and coda rhotics and laterals that often reduce to a front vocoid (Jiménez Sabater 1975). The acquisition of dialect-specific features of Dominican Spanish is not a focus of the present study. Nevertheless, we will return to the issue of how these dialectal features may influence acquisition for the SA group in the Discussion section.

2.4 Research questions

The present study builds upon previous research by expanding the sounds under investigation, using acoustic analyses and characterizations to account for L2 phonetic development abroad and at home, and investigating the impact of a short-term (i.e., less than 8-week) SA program, which represents the type of program that has grown in popularity among undergraduate students within the institutional context of the present study. The following research questions guide the present study:

- (1) Do L1 English-speaking learners of Spanish enrolled in an introductory Hispanic linguistics course at home show development (i.e., movement toward targetlike norms) in the production of word-initial /p t k/, intervocalic /b d g/, intervocalic /r/ and /r/, and word-final /l/ over a 5-week period?

- (2) Do L1 English-speaking learners of Spanish enrolled in the same course while studying abroad show development in the production of the same four groups of segments over the same time period?
- (3) How does the development of the AH and SA learners compare?

3 Method

3.1 Participants

A total of 27 intermediate-level learners of Spanish enrolled in a summer Introduction to Hispanic linguistics course at a large Midwestern university participated in this study: 12 participants in the AH group and 15 participants in the SA group.³ Table 2 provides a summary of the characteristics of the learners in both groups at the beginning of data collection; the information was taken from the background questionnaire, Pronunciation Attitudes Inventory (PAI; Elliott 1995), and proficiency test (all described in Section 3.2) completed at Time 1. The AH students were enrolled in the course at their home institution and attended class roughly 6.25 h per week over the 6-week course duration. The SA participants were participating in a 4-week SA program in the Dominican Republic. They were also enrolled in a culture course and attended 4 h of class (2 h linguistics, 2 h

Table 2: Summary of the learner groups.

Group	<i>n</i>	<i>M</i> proficiency score at Time 1 (out of 25)	<i>M</i> self-rating of outside-of-class Spanish use (1 = never; 5 = daily)	<i>M</i> years studying Spanish	<i>n</i> with previous study abroad experience	<i>M</i> PAI score (12 = negative attitude; 60 = positive attitude)
AH	12	12.5	3.9	4.8 years	4	43.67
SA	15	13.9	3.9	5.5 years	5	48.67

Note: The groups were not significantly different in terms of proficiency, $t(25) = -0.99$, $p = 0.332$, or years studying Spanish, $t(25) = -0.073$, $p = 0.48$. Differences in PAI scores were not tested, as this is an individual difference not necessarily expected to vary with experience or language proficiency.

³ The participant pool began at 42; 15 participants were eliminated from the data pool because (a) they did not complete the course, (b) they were native speakers of Spanish, or (c) there were errors with either of their recordings.

culture) 4 days per week in addition to participating in multiple cultural activities and homestay lodging with Dominican families. It is a limitation of the current study that no data regarding individual students' use of Spanish during SA was collected; nevertheless, the instructor of the program noted that although students were encouraged to speak Spanish, they were permitted to use English on excursions and when the entire group was together.

Because the programs (AH and SA) were occurring simultaneously, it was impossible to control for potential instructor effects. Both the AH and the SA classes were taught by nonnative Spanish-speaking instructors from the home institution who specialize in Hispanic linguistics. Given the differing interests and research foci of the two instructors (language contact and Spanish phonetics/phonology, respectively), the content of the classes – which generally follows a similar curriculum – may have varied slightly. In particular, the instructor of the SA class noted that the class regularly discussed the linguistic patterns of Dominican Spanish including the variations of the sounds reported in the current study. Especially, considerable class time was spent discussing linguistic behaviors that the students found challenging or that posed a barrier to understanding during the first 2 weeks of the program. The AH instructor also covered phonetics and phonology in her course but did not note particular sound foci.⁴

3.2 Data and elicitation

The current analysis examines learner speech based on two reading tasks: (a) three short passages that contained 36 words with the target segments and (b) a series of 124 carrier sentences containing the target segments. The reading passages were presented using Microsoft PowerPoint, and the recordings took place in a sound-attenuated recording booth and (for the SA group's second recording) a classroom at the SA program site. The AH group participants were recorded during the first and fifth weeks of class, and the SA participants were

⁴ As an anonymous reviewer pointed out, it is a limitation of this study that the AH and SA groups likely received different treatments. Especially considering the fact that explicit pronunciation instruction has been shown to be beneficial for phonetic and phonological development (e.g., Lee et al. 2014), it is possible that differences in instruction may have contributed to the different outcomes observed in the results of the current study. Nevertheless, given that all students were enrolled in the same course from the same institution during the same time frame, we believe that the groups likely received comparable instruction, and we believe that incorporating an AH comparison group, even if not a true control group, is superior to not including this AH comparison at all.

recorded the week prior to going abroad and during the middle of the fourth (and final) week of the program. Approximately 5 weeks elapsed between recordings for both groups. The recordings were made directly into a laptop computer using a USBpre external soundcard and a Shure head-mounted microphone (WH 20).

For the passage-reading task, the target segments were embedded in words that did not occur in phrase-final position. This design feature was incorporated to preemptively address the potential for creaky voice that is known to occur in words and segments appearing in this suprasegmental position (Epstein 2002). Because each task contained real words, and the same words were used at both data collection times, the particular vocalic contexts for intervocalic /b d g/, intervocalic rhotic segments, and word-initial /p t k/ were not controlled for. However, the vowel preceding word-final /l/ as the target segment was always /o/ or /e/ (e.g., *caracol* ‘snail,’ *clavel* ‘carnation’). The reading passages used to elicit data in the present study have been provided in Appendix A, with words containing the target segments in bold.

For the sentence reading task, all target segments occurred in real words appearing either in phrase-medial or phrase-final position in one of the following carrier sentence types: *Yo digo _____ para ti* ‘I say _____ for you’ or *Yo veo el _____* ‘I see the _____.’ The former sentence type was used for words containing the voiced and voiceless stops as well as the intervocalic rhotic segments, and the latter sentence type was used for words containing word-final /l/ as the target segment. Similar to the passage-reading task, the vocalic context for target segments (with the exception of word-final /l/) were not controlled for, but the same words were used at both data collection times.

At Time 1, all participants also completed a background questionnaire that gathered data on their language learning history and use, their attitudes toward L2 pronunciation accuracy (using Elliott’s 1995 PAI, see a sample in Appendix B), and their responses to a 25-item multiple-choice grammar proficiency test (see a sample in Appendix C) that was used to ensure that both groups were at comparable levels of general Spanish proficiency. An analysis of internal consistency demonstrated that the grammar test was reliable, $\alpha = 0.75$ (Nunnally 1978).

3.3 Analysis

All acoustic analyses were realized using Praat (Boersma and Weenink 2013). There was a theoretical ceiling of 8,640 tokens, but some productions were excluded due to disfluencies, creaky voice, or nonproductions, resulting in a

corpus of 8,400 tokens. Four segment classes were included in the study: word-initial voiceless /p t k/, intervocalic /b d g/, word-final /l/, and intervocalic /r/ and /r/. Productions of these segments were measured in the following ways.

The acoustic measurement for the word-initial voiceless stops was VOT, which was measured in milliseconds from the onset of the release to the beginning of voicing. Onset of VOT was defined as the beginning of the burst, at zero crossing. Offset of VOT was defined as the beginning of the vowel, manifested by periodicity in the waveform and consistent formant structure, at zero crossing. Figure 1 provides a visual representation of VOT onset and offset.

The realization of intervocalic /b d g/ was characterized using a relative intensity measure based on the difference between the maximum intensity of the following vowel and the minimum intensity of the target segment (e.g., Hualde et al. 2011). For this purpose, acoustic intensity curves were generated for the target consonants using the standard settings in Praat. Next, maximum intensity during the following vowel and the minimum intensity reading in the target phonemic stop were measured and the difference calculated. Figure 2 identifies the measurement landmarks discussed above.

The measure for the laterals was the frequency of F2, which, as mentioned, has been used in previous studies as an index of the degree of velarization of /l/ (e.g., Recasens 2004). The F2 measurement was taken 30 ms from the end of the segment (which was marked, following Simonet 2010, at the end of the last pitch period in which F2 could be observed), and these values were normalized using speakers' average F2 values for vowel extremes /i/ and /u/ to account for

Figure 1: Spectrogram of the word *caballo* ‘horse’ showing the boundaries of VOT for the phoneme /k/.

Figure 2: Spectrogram of the word *nube* ‘cloud’ showing the landmarks for the intensity measurements for /b/ in bottom tier.

Figure 3: Spectrogram of the word *tonel* ‘barrel’ showing the landmark (marked in bottom tier) for the /l/ formant measurement taken 30ms from end of word.

physiological differences that can affect formant measures. An example of the F2 measurement is provided in Figure 3.

The rhotics were characterized into a number of phonetic categories on the basis of acoustic and spectrographic analysis and auditory impressions. These phonetic labels were based on characterizations adapted from Face (2006), and Rose (2010) and are shown in Table 3.

The first three authors met and together coded approximately 200 tokens from all segment groups to ensure consistency in coding and to establish and define the labels for rhotic productions observed. Additionally, during the general coding process, all questionable tokens were discussed as a group and resolved, and,

Table 3: Descriptions of phonetic labels adopted for rhotics.

Phonetic labels	Acoustic description and cues
R-colored vowel	No clear constriction; pronounced dip in third formant (F3) and/or fourth formant (F4); rhotic can be perceived.
Laterals	Lateral; includes lateral followed by tap or rhotic approximant.
Rhotic approximant	Constriction is visible, but no full closure; boundaries cannot be established; dip in F3 and F4; gradual transitions.
+ Tap	Approximant realization or r-coloring followed by one full occlusion.
Lenited tap	Clear constriction, not easily separated from surrounding vowels; some formants continue through segment; dip in F3 and F4; similar to approximant but shorter in duration; transitions more abrupt.
Lenited tap +	Contains characteristics of a lenited tap followed by an approximant realization or r-coloring.
Tap	Full occlusion (including tap and release).
Tap +	One full occlusion followed by approximant realization or r-coloring.
Fricative	Fricative realization.
Intermediate trill	One full occlusion and one or more partial constrictions; often svarabhakti element is present between constrictions.
Trill	At least two occlusions.
Trill +	At least two full occlusions followed by r-coloring and gradual climb in F3.

later, a subset of 20–30 rhotic tokens per coder were reviewed together by the group to ensure uniform employment of the rhotic labels in Table 3.

For the comparisons of /p t k/, /b d g/, and /l/, repeated-measures ANOVAs were conducted, with group as a between-subjects variable and time and task as within-subjects variables.⁵ The comparison of the rhotic realizations was based on frequency counts for the different phonetic realizations, and chi-square analyses were employed to examine the existence of statistical differences in the distribution of the different realizations per group by time.

4 Results

4.1 VOT of word-initial /p t k/

Duration of VOT for word-initial /p t k/ was measured for both participant groups at Time 1 and Time 2. Table 4 presents mean duration values, standard deviations, and ranges for /p t k/ for the AH and SA groups at Time 1 and Time 2. Additionally, for comparison purposes, Table 4 includes mean VOT duration reference values for native speakers of Spanish reported in previous literature (Lisker and Abramson 1964; Rosner et al. 2000).

As shown in Table 4, mean duration values decreased from Time 1 to Time 2 for both the AH and the SA group. Nevertheless, for each phonological category and group, the decrease from Time 1 to Time 2 was small, and values did not approach those of native Spanish averages.

Three repeated-measures ANOVAs, one per word-initial voiceless stop, were conducted to examine the effects of group, task, and time on the duration of VOT. For /p/, the analysis revealed a statistical main effect for time, $F(1, 25) = 4.78$, $p = 0.038$, partial $\eta^2 = 0.16$, but no statistical main effect for task or group, and no significant interactions. Both participant groups significantly decreased VOT values for /p/ from Time 1 to Time 2. For /t/, the analysis indicated no significant main effects for time, task, or group, and no significant interactions. Lastly for /k/, the results of the analysis showed a statistical main

⁵ As pointed out by an anonymous reviewer, carrying out a series of repeated-measures ANOVAs has the disadvantage of increasing the probability of erroneously rejecting the null hypothesis. Although carrying out a single repeated-measures ANOVA for each group of segments (e.g., /p t k/) with segment as an independent variable is a potential solution for this issue, we ultimately decided against this statistical procedure given that previous research has shown distinct expected values or properties for different segments within a group (e.g., VOT values for /k/ are longer than /p/ and /t/).

Table 4: Descriptive statistics for VOT duration (measured in ms; $N = 2,130$; /p/, $n = 692$; /t/, $n = 594$; /k/, $n = 844$).

Group	Segment	Time 1			Time 2			Native Spanish averages	
		<i>M</i>	Min.–Max.	<i>SD</i>	<i>M</i>	Min.–Max.	<i>SD</i>	Puerto Rican Spanish (Lisker and Abramson 1964)	Castilian Spanish (Rosner et al. 2000)
AH	/p/	38	8–113	24	35	7–116	22	4	16
	/t/	44	10–147	31	42	10–136	27	9	14
	/k/	55	12–155	28	51	7–121	24	29	26
SA	/p/	41	4–140	26	37	6–123	28	4	16
	/t/	45	7–143	27	44	7–173	36	9	14
	/k/	58	15–155	29	53	10–183	33	29	26

effect for time, $F(1, 25) = 4.31$, $p = 0.048$, partial $\eta^2 = 0.15$, and a significant main effect for task, $F(1, 25) = 10.70$, $p = 0.003$, partial $\eta^2 = 0.30$, indicating that VOT values for /k/ were statistically shorter at Time 2 than at Time 1 for both groups, and were statistically shorter in the paragraph reading task than in the carrier phrase reading task at both times for both groups (see Appendix D for results of /k/ by task type). There were no statistical main effects for group nor were there any statistical interactions. Thus, overall, both the AH and the SA group reduced their VOT values for /p/ and /k/ from Time 1 to Time 2, and both groups had shorter /k/ VOT values on the paragraph reading task regardless of time.

4.2 Intervocalic /b d g/

The spirantization process was measured using relative intensity difference values previously described. Table 5 presents mean intensity differences in decibels (dB), standard deviations, and ranges for each segment at Time 1 and Time 2 for the AH and SA groups as well as intensity difference reference values for native Spanish speakers reported in previous literature (Hualde et al. 2011). It should be noted that, for /d/, 246 tokens were excluded from the intensity analysis because they were realized as phonetic taps.

A repeated-measures ANOVA for /b/ revealed a statistical main effect for group, $F(1, 25) = 5.32$, $p = 0.030$, partial $\eta^2 = 0.18$, in that the AH group’s productions exhibited smaller intensity differences (i.e., were more approximantlike) than the SA group’s productions at Time 1 and at Time 2. There

Table 5: Descriptive statistics for intervocalic /b d g/ (relative intensity, measured in dB; $N = 2,777$; /b/, $n = 905$; /d/, $n = 939$; /g/, $n = 933$).

Group	Segment	Time 1			Time 2			Native Spanish averages (Hualde et al. 2011)
		<i>M</i>	Min.–Max.	<i>SD</i>	<i>M</i>	Min.–Max.	<i>SD</i>	
AH	/b/	13.6	0–44.1	6.7	14.0	0.11–43.4	7.0	~7.5
	/d/	11.8	0–38.1	6.7	12.4	0–35.3	7.8	~5.0
	/g/	14.8	1.2–34.5	6.8	15.1	–0.99–39.7	7.5	~9.0
SA	/b/	17.5	1.2–42.6	7.9	15.5	0.4–39.7	7.3	~7.5
	/d/	15.6	–0.5–46.3	9.4	13.4	–1.7–40.4	7.8	~5.0
	/g/	16.8	–0.1–44.8	8.0	14.9	0.3–45.4	7.8	~9.0

Note: The native speaker averages presented in the far-right column are approximated from a figure in Hualde et al. (2011).

were no statistical main effects for task or for time, and no statistical interactions. For /d/, a statistical main effect was found for task, $F(1, 25) = 6.74$, $p = 0.016$, partial $\eta^2 = 0.21$, in that intensity differences were smaller in the paragraph reading task than in the carrier phrase reading task (see Appendix D for results of /d/ by task type). Additionally, a statistical Time $\times$ Group interaction was found, $F(1, 25) = 4.75$, $p = 0.039$, partial $\eta^2 = 0.16$, in that the SA group produced /d/ segments with larger intensity differences than the AH group at Time 1, but not at Time 2. Finally, for /g/, no statistical main effects or interactions were found. Thus, to summarize, the AH learners produced more approximantlike /b/s than the SA learners at Time 1 and Time 2, but there was no change for either group on this phone over time. For /d/, the SA group showed significant development in that, at Time 1, their intensity differences values were statistically greater than the AH group, but, by Time 2, the two groups were no longer different. Additionally, both groups produced more approximantlike /d/s on the paragraph reading task than on the carrier phrase reading task. No significant differences or changes were noted for /g/.

4.3 Word-final laterals

F2 measurements were taken 30 ms from the end of the lateral segment in target tokens for learners of both participant groups at Time 1 and Time 2. Table 6 shows the nonnormalized means for the F2 measurements for the AH and SA groups at Time 1 and Time 2. As can be observed, both the AH and the SA groups produced word-final laterals with considerably lower F2 values (i.e., darker or more velarized) than native Spanish averages at both Time 1 and Time 2.

Table 6: Descriptive statistics for word-final /l/ (F2, measured in Hz; $N = 860$).

Group	Time 1			Time 2			Native Spanish average (Recasens 2012)
	<i>M</i>	Min.–Max.	<i>SD</i>	<i>M</i>	Min.–Max.	<i>SD</i>	
AH	1,381	734–2,887	386	1,377	731–2,431	375	1,530–1,800
SA	1,378	733–2,001	297	1,384	684–2,046	329	

As Table 6 shows, F2 values remain relatively stable from Time 1 to Time 2 for both the AH and the SA group. As was previously mentioned, formant values were normalized to permit comparisons between speakers and groups; the statistical analyses were run using the normalized values. A repeated-measures ANOVA showed no statistical main effects or interactions for the normalized F2 values. Thus, no change was observed in lateral production for either participant group.

4.4. Rhotics

Rhotic tokens were coded using the labels described in Table 3. The frequency of production, in percentages, for each type of rhotic (i.e., approximant, tap, tap + , trill, etc.) was examined for both participant groups at Time 1 and Time 2. Figure 4 presents the percentages of each type of realization for phonemic taps at Time 1 and Time 2 for each group.

As shown in Figure 4, at Time 1 a phonetic tap realization was the most frequent realization for a phonemic tap by the AH group, occurring in roughly 28% of phonemic tap contexts, followed by approximants (24%), lenited taps (21%), and r-colored vowel productions (11%). The most frequent realization in phonemic tap contexts by the SA group at Time 1 was a phonetic tap (28%), followed by approximants (18%), tap + productions (16%), and lenited taps (15%).

Figure 4: Percentage of all rhotic types produced in phonemic tap contexts by the AH and SA groups at Time 1 ($n = 253$ for AH and $n = 332$ for SA) and Time 2 ($n = 262$ for AH and $n = 326$ for SA).

At Time 2, the percentage of tap productions decreased (to 21%) for the AH participants, and they increased their production of lenited taps (to 26%) and r-colored vowels (to 14%); approximants were produced with the same frequency as taps (21% of productions) at Time 2, and the production of tap + variants increased (from 6% at Time 1 to 11% at Time 2). For the SA participants, at Time 2, the frequency of phonetic tap productions increased (to 34% of all phonemic taps). Additionally, the percentage of approximant productions decreased (to 10%), whereas a higher percentage of lenited taps (20%) and tap + realizations (16%) were produced than at Time 1. In comparing changes in tap production at Time 1 and Time 2 for the AH and SA groups, the SA group made greater gains in decreasing nontaplike variants (i.e., r-colored vowel and approximant productions) and increasing taplike productions (i.e., phonetic taps, lenited taps, + tap and tap + productions); this change in the distribution of taplike versus nontaplike realizations was significant, $\chi^2(1, N = 658) = 6.45$, $p = 0.01$, Cramer's $V = 0.099$. The AH group did not make targetlike gains; instead, they decreased their production of phonetic tap realizations and increased their production of approximant realizations at Time 2. The difference in distributions of taplike and nontaplike variants between Time 1 and Time 2 was not statistically significant for the AH group.

The results for rhotic production in phonemic trill contexts were, in many ways, similar to the results for the phonemic taps. Figure 5 presents the percentage of production of the rhotic variants in phonemic trill contexts by the AH and SA groups at Time 1 and Time 2.

At Time 1, the tap was the most frequent variant (23% of trill contexts) for AH participants, followed by the lenited tap (16%), the approximant (15.5%), the tap + (12%), and the phonetic trill (11%). For SA participants, on the other hand, phonetic trills were the third most common variant produced in phonemic trill contexts (15.5%), exceeded only by taps (18%) and tap + productions (16%) at Time 1.

Figure 5: Percentage of all rhotic types produced in phonemic trill contexts by the AH and SA groups at Time 1 ($n = 232$ for AH and $n = 300$ for SA) and Time 2 ($n = 236$ for AH and $n = 295$ for SA).

At Time 2, there was little evidence of development toward a targetlike trill production for the AH participants. In fact, production of a phonetic trill decreased slightly (to 10% of phonemic trill contexts), and the production of trill-like variants such as intermediate trills and trill + productions remained minimal. Instead, there was an increase in the production of lenited taps (to 20% of trill contexts) and approximant productions (to 19%). The SA group, in contrast, showed some movement toward increasing targetlike trill production, indicated by an increase in the production of trill-like variants at Time 2 as compared to Time 1 and a decrease in the production of nontrill-like variants (i.e., r-colored vowel, approximant, fricative, intermediate trill, trill and trill +). Although the percentage production of phonetic trills decreased slightly (to 14%), the production of trill-like variants (i.e., intermediate trills and trill + productions) increased. At Time 1, these three trill or trill-like variants constituted 31% of phonemic trill productions; at Time 2, they constituted 35%. Additionally, although not indicative of production of targetlike trills, the biggest change between Time 1 and Time 2 for the SA group in trill contexts was an increase in tap productions (to 23% of all trill variants); this is coupled with a decrease in the production of variants such as an r-colored vowel, approximant, or lenited tap (each produced less than 10% of the time at Time 2). This contrasts with the AH group, who increased their production of these nontrill-like variants in trill contexts at Time 2. With regard to the phonemic trill, although the SA group appears to have made more gains (i.e., greater production of trill-like variants) than the AH group, neither group showed statistically significant differences in the distribution of trill-like and nontrill-like variants at Time 1 versus Time 2. Taken together, these results suggest that in the 5 weeks between Time 1 and Time 2, the SA group moved toward targetlike production of phonemic taps, whereas the AH group showed no statistical change. With regard to phonemic trills, neither group exhibited a statistical change in the distribution of trill-like as compared to nontrill-like variants.

4.5 Results summary

Table 7 summarizes the results observed for both groups in terms of change in segmental production during the 5-week period.

As the summary in Table 7 indicates, the SA group does make some improvements that the AH group does not, including in the approximant realization of /d/ and in the realization of phonemic taps. Nevertheless, the general picture of development over this 5-week period and of the potential

Table 7: Summary of results.

Segment groups	Results
Word-initial/ <i>p t k</i> /	Both groups significantly decreased VOT from Time 1 to Time 2 for <i>/p/</i> and <i>/k/</i> . No change in VOT for <i>/t/</i> . No differences between SA and AH group. More targetlike <i>/k/</i> VOTs on paragraph task.
Intervocalic/ <i>b d g</i> /	The SA group's <i>/b/</i> was significantly less targetlike (i.e., had greater intensity difference) than the AH group's at Time 1 and Time 2. The SA group's <i>/d/</i> was significantly less targetlike at Time 1 than the AH group's; at Time 2, the groups are no longer statistically different. More targetlike <i>/d/</i> production on paragraph task. No change and no group differences for <i>/g/</i> .
Word-final <i>/l/</i>	No change from Time 1 to Time 2. No differences between SA and AH groups.
Intervocalic/ <i>r/</i> and <i>/r/</i>	SA group increased targetlike <i>/r/</i> and <i>/r/</i> production at Time 2 and decreased production of nontap- and nontrill-like variants. Differences between Time 1 and Time 2 were only significant for phonemic taps produced by the SA group. AH group did not show targetlike changes.

influence of context of learning is somewhat obscured by group differences at Time 1 (as, for example, in the Time 1 differences between the SA and AH groups in */d/* production). To better account for Time 1 differences and individual variability, we examined the data more closely to investigate individual patterns of gains (or not) over the 5-week period. To account for Time 1 differences and to explore individuals' trajectory in phonetic development over the study period, we (a) examined learners' starting and ending points for each segment, (b) identified learners who, regardless of group, showed improvement across a majority of segments, and then (c) examined these learners' responses to the various questions on the background questionnaire. In what follows, we present brief descriptions of these learners and, at the end, examine the potential relationship between these individual findings and the broader learning context. A summary of all individual learners' results is provided in Appendix E.

4.6 Individual results

Three learners were identified as showing consistent gains across all or a majority of the segments under investigation. Only one learner, P3 of the SA

group, showed improvement on all segments. This participant decreased her VOT on /p t k/ an average of 18 ms across segments and decreased the range in her VOT production for all three stops, suggesting a stabilization in her realization of these segments (at Time 1, P3 produced average VOTs for all three stops above 45 ms; by Time 2, the average VOT values for /p/ and /t/ were at or below 30 ms, and for /k/, had dropped from 59 ms to 42 ms). For /b d g/, P3 decreased her average intensity difference between the following vowel and the target approximant segment from 15.39 dB to 11.45 dB and the range of intensity differences produced within each segment decreased at Time 2, indicating that her /b d g/ productions were also becoming less variable. With regard to the lateral, P3 increased the F2 value of her word-final /l/s from an average of 1,004 Hz in -ol contexts at Time 1 to 1,101 Hz at Time 2, and from 1,610 Hz in -el contexts at Time 1 to 1,748 Hz at Time 2. Finally, P3's rhotic productions were characterized by a decrease in the number of approximantlike variants in phonemic tap contexts at Time 2 (with most productions being lenited tap+ and taps). In trill contexts, P3 demonstrated an increase in the production of trills and intermediate trills and a sharp decrease in the production of approximants and lenited taps that were produced most often at Time 1. It is notable that P3 started with production values for word-initial stops, intervocalic approximants, and word-final laterals at Time 1 that, although not within the cited nativelike ranges, were more targetlike than average for both the SA group and the AH group at Time 1.

Participants 17 and 24 also performed well, improving on most segments. P17, also of the SA group, decreased her VOT values an average of 17.7 ms per segment and drastically reduced the range of VOT values she was producing. She also improved on all three approximant segments, reducing her average intensity difference measure from 19.71 dB at Time 1 to 17.18 dB at Time 2. For /l/, P17 showed development in producing a lighter /l/ by Time 2, averaging 1,186 Hz at Time 1 and 1,289 Hz at Time 2 overall. With regard to rhotics, no increase in canonical tap or trill productions was observed (in fact, P17 did not produce a trill-like variant at either time), but she did reduce her production of approximant variants for both segments at Time 2. P24, also from the SA group, was the only other participant to show consistent improvement across the majority of segments. Although P24 showed no real improvement for VOT production (and averaged VOT values of 78.5 ms at Time 2), gains were observed for /b d g/, both rhotic segments, and, to a lesser extent, /l/. The average relative intensity difference for P24's approximant productions decreased from 20.02 dB at Time 1 to 17.40 dB at Time 2, as did the overall ranges in intensity differences. For /l/, the average F2 values for P24 increased from 1,090.5 Hz to 1,126.5 Hz between Time 1 and

Time 2, and, for rhotics, P24 increased her production of trill-like variants in phonemic trill contexts at Time 2. In tap contexts, she decreased the number of approximantlike productions and increased the number of phonetic tap productions.

Although these three learners made broad phonetic gains (i.e., gains across multiple groups of segments), and were the only learners to do so, inspection of their background characteristics and Time 1 starting points for the phonetic measurements taken revealed no apparent overarching pattern that grouped these three learners together. All were relatively average (or slightly below average) with respect to Spanish language proficiency at Time 1 (proficiency scores of 13, 12, and 10 compared to the overall average of 13.26), some started at more targetlike levels for certain segments than others, and, when compared to the group's mean PAI of 46.44, these learner's PAI scores were average (P3, PAI of 46), below average (P24, PAI of 42), and above average (P17, PAI of 48). Two of these three learners reported studying Spanish for 6 years or more prior to this study (P3: 9 years; P24: 6 years), and the one learner, (P17) who had been studying Spanish for only 3 years, also had knowledge of French. Nevertheless, these three participants did belong to the SA group. Their widespread (i.e., across several segments) individual gains were perhaps lost in the group data, in which group averages obscure the fact that, whereas some learners made very large gains on just one or a few segments, others, like these participants, showed consistent, albeit less striking, gains across all sound groups and segments.

No AH learner made consistent gains across the segments under investigation. Although some made significant gains for a particular segment (e.g., AH learners P44 and P45 for /p/ and /k/ and just for /p/, respectively, and P35 for /g/ and /r/), more SA learners appeared to make more general gains across multiple segments (e.g., in addition to those mentioned above, P6 showed gains for /p t k/ and for /b d g/; P13 showed gains for /p t k/ and for /l/; and P1 showed gains for /p t k/, /b/ and /g/, and /r/, with moderate gains for /l/, but mostly in the context of *-ol*).

5 Discussion

This study compared the short-term phonetic development of two groups of learners, one studying abroad in the Dominican Republic and the other studying in an AH setting, for four different groups of segments. Both participant groups were enrolled in the same introductory Hispanic linguistics course and were recorded at the beginning and the end of their courses or time abroad, with

approximately 5 weeks in between recordings. In response to the first research question guiding the present study (i.e., whether or not AH learners demonstrate development in the production of the segments under study), the results revealed that the AH group demonstrated very little phonetic development in the segments under study. Specifically, statistically significant improvement was observed only for /p/ and /k/ over the 5-week period. The SA group (Research Question 2), in contrast, demonstrated statistically significant improvement for /p/, /k/, /d/, and the phonemic tap.

A comparison of the phonetic development observed for each group (i.e., Research Question 3) reveals slightly more gains for the SA group than the AH group. However, it is important to note that the SA group's /d/ productions at Time 1 were less targetlike than the AH group's productions of this segment at the beginning of the 5-week period, suggesting that the SA group had more room to improve. In spite of this finding, the SA group's improvement on the phonemic tap lends support to the notion that the SA setting may facilitate greater phonetic development of some Spanish segments over a fairly short period of study.

An additional finding of note in the present study is the absence of any apparent pattern or profile of individual characteristics to better understand the variation in gains observed across segments at the level of the individual. However, the three learners who made the broadest gains (i.e., gains across all segment types) belonged to the SA group. Given the modest sample of learners studied, we cannot conclude that the SA context facilitated the development of a greater number of segment types than the AH setting. However, at the present, the analysis of individual results in addition to group results does contribute positively to understanding the variation present in L2 learning at the phonetic level (cf. Bayley and Langman 2004).

When comparing our results to the existing body of literature, this study not only corroborates some previous findings but also adds additional and important detail in its (a) employment of spectrographic analyses, (b) inclusion of an AH comparison group, and (c) investigation of a short-term (i.e., 4 week) program. Table 8 illustrates how the results of the present study compare to those of the previous studies described in Section 2.

As can be observed in Table 8, the results of the current study coincide with previous studies in some respects, but contrast with previous findings in other cases. Similar to Díaz-Campos (2004, 2006), the present study found that the production of word-initial stops improved over time, regardless of learning context (although the present analysis showed statistical gains for /p/ and /k/ only). Likewise, if we consider the SA group's improvement on /d/ in isolation (i.e., not as compared to the AH group), the

Table 8: Summary of previous and present findings.

Segment groups	Example studies examining target segments	Positive effect of SA setting?	
		Previous studies (8 weeks–2 years)	Current study (4 weeks)
Word-initial/p t k/	Díaz-Campos (2004, 2006)	=	=
	Crane (2011)	+*	(/p/ and /k/)
Intervocalic/b d g/	Díaz-Campos (2004, 2006)	×	×
	Lord (2010)	+*	(/b/ and /g/)
	Alvord and Christiansen (2012)	+*	+ (/d/)
Word-final /l/	Díaz-Campos (2004, 2006)	=	×
Intervocalic/r/ and /r/	None to date	n.a.	+

Note: = similar gains observed for SA and AH groups; × no gains (i.e., no positive effect of SA) observed; + positive effect of SA (in contrast to AH) observed in gains; *improvement was noted, but no AH comparison group employed.

findings reported in this study reflect the findings reported by Lord (2010), and Alvord and Christiansen (2012) but not Díaz-Campos (2004, 2006). Lastly, unlike Díaz-Campos (2004, 2006), no improvements in the production of word-final laterals were observed in the present study for either learner group. The differences in findings for the approximant and lateral segments may be due to differences in the methodology and analyses employed (e.g., the use of F2 to examine lateral production and relative intensity measures for spirantization) or the markedly shorter time period investigated in the present study (4 weeks, as compared to SA periods of 8 weeks (Lord 2010), 10 weeks (Díaz-Campos 2004, 2006), and 2 years (Alvord and Christiansen 2012)).

With regard to the advantage of the SA context for development of the rhotic segments (specifically, the phonemic tap), it is possible that the SA learners, who were exposed to a variety of Spanish that has been documented to show unique differences from other varieties in its production of rhotic variants, noticed or paid more attention to the realization of these specific phones while abroad. Constructs such as noticing and/or awareness of specific phones were not measured or addressed in the current study, but this possibility suggests an avenue for further research on the role of dialect-specific variants in overall phonetic or phonological development and specifically within the context of SA.

What is clear from the findings of this study and previous studies that examine a variety of segments (e.g., Díaz-Campos 2004, 2006) are inconsistent patterns of development by segment type (with the exception of the three SA

learners discussed previously). In other words, development is often observed for one set of segments but not another. This observation, which was evident not only in the group results but also the individual results, makes us pause to consider more closely how the task of acquiring, for example, word-initial /p t k/ is fundamentally different from acquiring, for example, intervocalic /b d g/. For an English-speaking learner of Spanish, acquiring word-initial /p t k/ minimally involves shortening VOT and lengthening the duration of the voiceless closure interval (Zampini 2013). Acquiring intervocalic /b d g/, in contrast, involves acquiring two phones that do not exist in learners' L1 English inventories along with acquiring the positional constraints and phonological processes associated with these phones. That learners do not demonstrate notable development or improvement on some segment types – particularly, for the SA learners, in spite of (potential) additional exposure to such segments in a wider variety of target language settings – may point to the need for intervention to facilitate the process of acquiring those segments. Explicit instruction and practice while studying abroad could further facilitate the acquisition of certain segments even in the short term, as the findings reported by Lord (2010) for the approximant segments suggest.

Taken together, the findings reported in the present study provide some evidence for the notion that the SA context is conducive to improvement on the production of some L2 speech segments at the phonetic level over a relatively short stay abroad. However, more research that compares the potential gains for a variety of segment types over different periods of stay abroad is needed to continue this discussion in the existing literature. Nevertheless, this study offers two important contributions more generally to the field of SLA. First, this study has advanced the field by offering a picture of phonetic development (albeit in the short term) of classroom learners, which represents a rather under-researched area in comparison to the existing literature on L2 morphosyntactic development. Second, the findings of this study have demonstrated that there indeed exists some interaction between phonetic development in the short term and the role of the learning context. More research is needed that (a) compares phonetic development over different periods of stay abroad (e.g., 4 weeks vs. one semester vs. one year) for different segment types (e.g., word-initial stops vs. intervocalic rhotics), (b) includes more information regarding learners' contact and involvement with the language during the studied time periods, and (c) examines the influence of dialect-specific phenomena in this development; however, at the present, this study contributes to the literature examining L2 development and how such development may or may not differ by context of learning. Additionally, this examination of a short-term SA program offers

information regarding the developmental outcomes that can practically be expected during these types of programs, which are quickly becoming the most popular and sought after lengths of SA.⁶

Our results, of course, should be interpreted in light of certain limitations of our analyses. In addition to those limitations already recognized (i.e., the lack of a true control group given instructor differences and lack of information on contact with Spanish during the time period under investigation), it should also be kept in mind that, in an attempt to standardize the analysis of each segment and to offer a survey of phonetic development of several groups of segments, only one acoustic correlate of targetlike segmental production was analyzed (for example, VOT for /p t k/), even though segmental acquisition certainly includes adjustment of more than a single phonetic feature. Future investigations that focus on individual segments can offer a more detailed picture of the multiple phonetic adjustments made by learners in both learning environments. Similarly, the present study's focus on production provides only half of the picture of phonetic development; it is possible that information about the perceptual system of these learners could provide additional insight into the role of context of learning in the development of the L2 phonetic system. Finally, the findings reported in the present study are based on read (i.e., nonspontaneous) speech, which imposes certain limitations on our understanding of the nature of speech production from a broader perspective (cf. Zampini 1994 for voiced intervocalic stops). Differences by task type were found in the present study for some segments, always in the direction of more targetlike speech produced in the less controlled task. Future analyses should incorporate data from other task types, particularly those eliciting (semi)spontaneous speech, to gain a fuller understanding of the production of the speech segments under study.

⁶ One anonymous reviewer suggested that the fact that this study examined a SA program that lasted only 4 weeks should be considered a limitation. Although we understand this reviewer's position, given the growing enrollment in these types of programs and the types of foreign language credits students receive for such short-term experiences, we believe that this is actually a strength and an important contribution of the present study. Additionally, it is interesting to note that Henriksen et al. (2010) showed development on the part of SA learners with regard to regional intonational patterns after just 6 weeks, suggesting that phonological development in the short-term, especially in a supposedly input-rich environment such as SA, is possible. We believe that the present study adds further evidence to this general finding.

6 Conclusion

This study presented a survey of L2 phonetic development over a short-term period by learners participating in a SA program in the Dominican Republic or in the AH environment. By means of phonetic and spectrographic analyses and statistical comparisons with an AH group, the present study has offered evidence in favor of a minor benefit of the SA context for L2 phonetic development of some Spanish segments, specifically intervocalic /d/ and intervocalic /r/. Combined with previous findings, this study contributes to our knowledge of the impact of the learning context (specifically, SA) and suggests that the SA environment, even in the short term, may confer additional, minor benefits for L2 phonetic development. Future research in this area, including with the present corpus, will continue to increase our understanding of the interaction between contextual and individual factors and how they can combine to produce the best possible environment for L2 phonetic and phonological development.

Appendix A

Reading passages with target words in bold

Passage 1

Pablo quiere tener una mascota. El problema es que la mamá no lo deja, sin importar de qué mascota se trata. Pablo le ofreció varias opciones, pero ella encontró un problema con cada una de ellas. Un **perro** suelta mucho **pelo** y siempre tiene el **morro** sucio. Un **toro** seguro que come mucho (¡qué caro será darle de comer!). Una **araña** espanta a las visitas. Y ni hablar de un **caracol**. Es un animal demasiado lento. Un **zorro** es un lindo animal, pero **todo** el tiempo, la mamá piensa que habrá **pelo** por todas partes, que la **cola** del animal tirará el **jarrón** de la sala y que, en el jardín, arruinará el **clavel**. Quizás un **caballo** ... ¿comerá **arroz**? ¡Tener una mascota es imposible! Será mejor conseguir un **abogado** para resolver esta cuestión familiar.

Passage 2

A ver ... tengo que armar la lista de materiales que necesito para mi clase de dibujo. Primero y principal, necesito un **pincel**. ¿Qué más hace falta? Mmmm

... creo que también tengo que comprar acrílicos. Voy a comprar de color **dorado** y de color celeste. El **dorado** ideal para el dibujo de la **torre** hecha de lingotes de **oro** que pidió de tarea la profesora. Y de fondo voy a pintar un cielo despejado muy celeste, sin ninguna **nube**. Será un gran **golpe** de creatividad. Y para el dibujo de naturaleza muerta, voy a imaginar una escena en una cocina en la **edad** media y voy a pintar un **higo** junto al **fuego**. También tengo que comprar para eso. ¿Qué más? Por las dudas, también voy a comprar **papel**.

Passage 3

Me gustan los cuentos de fantasía. Me gusta que siempre hay un **hada** y un **mago** que resuelven los problemas de todos. También me gustan esos detalles que luego se convierten en símbolos. Por ejemplo, el **cabello** largo de Rapunzel, las **migajas** de Hansel y Gretel o los nariz larga de **madera** de Pinocho.

Appendix B

Sample items from Pronunciation Attitude Inventory (from Elliott 1995)

	(Almost) always true of me	Usually true of me	Somewhat true of me	Usually not true of me	(Almost) never true of me
1. I'd like to sound as native as possible when speaking Spanish.	☐	☐	☐	☐	☐
2. Acquiring proper pronunciation in Spanish is important to me.	☐	☐	☐	☐	☐

Appendix C

Sample items from Proficiency test

Creo que es muy interesante ____ de los hábitos alimenticios de la gente.

- ☐ hablo
- ☐ hablar
- ☐ hablando

Yo, por mi parte, ____ vegetariana.

- ☐ soy
- ☐ estoy
- ☐ tengo

Appendix D

Table 9: Mean VOT duration (in ms) of /k/ by task type for each group.

Task type	AH		SA	
	Time 1	Time 2	Time 1	Time 2
Paragraph	49.1 (20.5)	42.0 (12.0)	49.1 (17.3)	45.2 (21.3)
Sentence	57.0 (25.9)	53.4 (19.9)	59.4 (26.2)	55.0 (31.4)

Note: SDs in parentheses.

Table 10: Mean relative intensity (in dB) of /d/ by task type for each group.

Task type	AH		SA	
	Time 1	Time 2	Time 1	Time 2
Paragraph	11.2 (3.6)	12.1 (5.0)	14.5 (4.9)	13.1 (6.6)
Sentence	12.5 (3.2)	13.3 (6.2)	16.6 (6.0)	13.5 (5.0)

Note: SDs in parentheses.

Appendix E

Table 11: Summary of individual results for VOT (in ms).

		/k/						/p/						/t/					
		Time 1			Time 2			Time 1			Time 2			Time 1			Time 2		
		M	Min	Max	M	Min	Max	M	Min	Max	M	Min	Max	M	Min	Max	M	Min	Max
AH	P25	68	32	96	70	36	99	47	17	76	58	18	116	50	17	89	71	40	136
	P28	30	17	58	33	14	60	30	20	60	18	7	33	22	15	30	22	13	36
	P30	55	37	76	47	18	64	42	17	63	38	21	64	53	21	95	35	12	54
	P31	53	45	66	52	35	73	31	22	48	36	22	54	45	30	81	51	28	64
	P32	34	20	77	34	22	52	17	9	30	20	12	36	13	9	22	17	11	34
	P33	42	24	63	42	26	78	23	11	52	32	14	85	23	14	32	22	10	40
	P35	62	33	82	50	34	108	31	13	69	26	13	56	61	19	125	37	15	63
	P37	77	42	111	64	39	115	42	17	65	28	13	59	60	28	147	45	19	60
	P40	23	13	35	29	7	76	12	8	20	14	10	24	13	8	16	19	14	29
	P41	100	18	155	85	24	121	65	33	98	60	22	90	78	45	120	73	41	109
	P44	85	64	119	71	46	105	83	63	113	65	45	86	89	31	122	89	66	130
	P45	36	12	68	36	18	85	28	13	61	22	9	50	20	13	33	26	10	60

SA	P1	60	43-90	30	16-46	38	23-67	17	11-20	42	30-54	22	11-46
	P3	59	39-82	42	24-76	45	28-80	27	11-61	49	20-80	30	18-57
	P6	42	25-96	34	23-53	23	10-68	20	11-42	20	8-81	16	11-26
	P9	28	18-46	32	12-76	14	4-29	11	6-15	11	7-16	12	8-27
	P10	82	32-140	61	28-139	72	16-140	48	17-93	73	43-127	52	21-95
	P11	38	18-59	37	22-80	26	11-44	20	14-30	32	14-58	25	17-34
	P12	95	48-144	123	61-167	72	41-103	85	48-117	81	45-143	108	50-152
	P13	65	35-97	38	21-64	35	16-73	27	16-58	41	25-54	27	12-41
	P14	36	24-58	45	10-69	27	14-41	27	11-61	26	13-37	31	15-57
	P17	51	24-103	34	21-94	27	12-40	12	7-15	38	22-78	17	7-34
	P18	58	30-84	62	30-89	42	28-52	47	26-72	52	18-72	60	37-83
	P20	30	15-60	29	19-48	21	11-46	23	6-84	26	14-63	22	11-59
	P21	34	25-47	40	26-57	24	14-41	33	21-63	27	17-38	31	23-45
	P23	102	55-155	106	55-183	64	20-88	82	17-123	67	21-114	108	69-173
	P24	82	56-113	82	61-109	79	43-107	63	47-95	81	70-97	84	59-116

Table 12: Summary of individual results for /b d g/ (in dB).

			/b/			/d/			/g/						
Time 1						Time 2			Time 1			Time 2			
			M	Min-Max	M	Min	Max	M	Min-Max	M	Min-Max	M	Min-Max	M	Min-Max
AH	P25	14.60	7.13–21.85	15.27	6.84	23.54	14.37	7.49–20.40	13.93	6.12–24.19	14.84	4.90–33.13	16.10	5.31–22.18	
	P28	10.14	2.08–20.43	12.83	3.74	22.85	11.79	1.68–22.52	10.80	0.14–24.34	14.71	1.33–26.53	18.15	9.08–26.91	
	P30	12.60	7.22–31.19	13.45	4.23	31.77	12.02	3.82–17.11	16.08	4.77–22.21	12.36	4.51–20.56	18.25	3.29–31.57	
	P31	14.16	7.67–23.12	16.16	0.92	43.41	16.01	11.48–23.34	19.78	11.38–30.30	10.18	1.20–22.91	10.62	1.01–20.38	
	P32	12.59	2.35–23.79	13.80	2.49	23.74	8.28	0.00–19.26	6.29	0.00–27.96	15.77	8.29–22.74	15.38	0.00–26.56	
	P33	12.86	0.00–24.16	11.95	4.87	25.27	9.33	0.00–23.66	6.56	0.00–17.88	15.45	2.96–24.02	12.32	4.60–28.84	
	P35	17.08	3.10–39.98	11.45	4.57	21.03	10.14	0.00–21.35	13.46	0.00–25.65	16.32	1.68–32.52	11.66	0.41–20.88	
	P37	8.17	4.25–15.28	8.72	2.57	18.30	7.96	0.76–20.73	6.77	0.66–16.10	9.91	4.44–17.35	6.83	–0.99–16.82	
	P40	14.22	0.01–44.07	11.13	0.11	27.40	10.45	2.35–22.56	7.95	1.18–22.22	13.33	2.92–25.45	12.99	1.28–39.69	
	P41	13.19	4.84–28.41	16.86	9.90	23.65	13.49	4.75–24.91	15.57	1.27–24.20	14.52	4.56–26.89	16.68	0.00–25.10	
P44	13.77	10.58–16.84	15.92	7.10	22.79	15.36	6.57–20.40	17.39	4.75–26.29	18.63	7.49–34.48	21.46	12.99–32.01		
P45	19.76	10.37–25.32	20.77	12.72	33.21	16.95	2.53–38.14	23.34	7.89–35.28	21.25	11.19–30.39	20.75	11.89–37.08		

SA	P1	20.11	10.72-34.89	12.92	2.86	34.79	18.64	5.49-35.66	19.38	6.98-27.59	20.18	8.71-35.49	16.01	6.31-31.83
	P3	17.97	5.02-32.28	12.75	5.46	18.21	20.38	8.12-26.70	10.51	0.98-16.09	12.80	3.90-26.98	12.37	6.25-18.01
	P6	14.97	4.30-26.87	15.10	0.42	29.45	18.36	0.43-36.88	13.98	0.00-23.42	13.90	7.75-22.33	13.17	2.43-35.20
	P9	13.41	2.32-21.76	17.97	3.29	26.13	12.65	1.19-22.08	12.77	3.74-22.64	13.54	2.40-33.52	11.30	0.25-30.27
	P10	19.99	3.91-42.64	10.21	5.77	19.07	18.67	3.63-33.69	7.58	1.52-15.99	20.69	8.58-33.96	11.98	0.70-23.89
	P11	11.33	1.19-16.46	10.91	5.87	17.68	6.92	-0.14-17.70	6.81	1.74-15.42	9.72	1.98-20.27	5.72	1.49-12.77
	P12	27.02	19.10-39.75	27.02	19.10	39.75	25.92	14.36-40.38	26.06	13.53-40.38	23.30	14.90-33.77	26.33	14.90-45.35
	P13	12.19	3.14-23.37	11.58	2.74	29.97	12.67	3.49-21.31	10.30	0.44-32.08	13.34	5.86-21.18	12.50	5.51-20.04
	P14	13.00	3.31-22.35	13.01	0.71	22.10	8.95	0.21-24.63	13.01	2.46-26.52	11.03	3.10-28.94	12.95	3.76-25.90
	P17	22.18	7.08-36.96	20.46	2.11	36.79	20.93	3.15-33.79	14.74	1.25-35.27	22.60	3.61-37.39	16.62	3.61-33.89
	P18	14.83	2.58-25.14	12.96	4.28	21.10	10.45	5.10-16.40	6.91	-1.74-16.16	13.88	5.79-22.55	15.44	4.80-25.60
	P20	16.82	9.44-27.21	19.23	10.74	23.91	13.91	2.25-34.46	15.82	6.34-23.00	19.56	10.03-30.10	19.07	12.03-25.90
	P21	15.88	3.67-34.20	15.36	2.20	30.08	10.18	-0.49-23.62	10.90	0.32-21.85	11.73	-0.10-24.70	12.85	3.61-23.17
	P23	25.46	12.39-35.82	18.04	11.85	26.03	22.03	1.61-42.78	13.07	4.20-23.29	24.31	12.26-44.79	18.14	11.81-32.93
	P24	17.58	6.56-29.79	16.64	8.25	20.25	20.45	0.91-46.27	17.11	6.24-28.85	22.02	8.98-37.69	18.44	12.18-23.11

Table 13: Summary of individual results for /l/ (F2 measured in Hz for leftmost Time 1 and Time 2 columns; normalized values for rightmost Time 1 and Time 2 columns).

		Time 1			Time 2			Time 1			Time 2		
		<i>M</i>	Min–Max		<i>M</i>	Min–Max		<i>M</i>	Min–Max		<i>M</i>	Min–Max	
AH	P25	1,813	1,492–2,156		1,789	1,651–1,920		–0.01	–0.19–0.18		–0.02	–0.10–0.05	
	P28	1,494	1,318–1,823		1,179	995–1,717		–0.22	–0.32–0.03		–0.40	–0.51–0.09	
	P30	1,215	734–1,751		1,197	769–2,007		–0.35	–0.73–0.08		–0.36	–0.70–0.28	
	P31	1,117	744–2,509		893	731–1,053		–0.70	–1.22–1.25		–1.02	–1.24–0.79	
	P32	1,798	1,130–2,270		1834	1,144–2,431		0.04	–0.39–0.34		0.06	–0.38–0.44	
	P33	1,448	965–2,205		1,449	888–2,069		–0.28	–0.58–0.18		–0.28	–0.63–0.10	
	P35	1,441	1,025–2,887		1,266	1,020–1,647		–0.15	–0.47–0.94		–0.29	–0.47–0.00	
	P37	1,407	1,153–1,925		1,456	1,021–1,745		–0.31	–0.47–0.02		–0.28	–0.55–0.09	
	P40	1,560	1,132–1,975		1,665	1,083–2,071		–0.12	–0.37–0.13		–0.05	–0.40–0.19	
	P41	1,146	902–1590		1,412	995–1,869		–0.44	–0.60–0.13		–0.25	–0.54–0.06	
	P44	1,131	917–1,422		1,195	1,038–1,384		–0.48	–0.61–0.31		–0.44	–0.54–0.33	
	P45	1,035	858–1,336		1,011	746–1,385		–0.41	–0.51–0.24		–0.42	–0.58–0.21	

SA	P1	1,398	989-1,871	1,397	1,007-1,920	-0.35	-0.58-0.07	-0.35	-0.57-0.04
	P3	1,355	733-1,747	1,489	942-2,046	-0.33	-0.66-0.12	-0.26	-0.55-0.04
	P6	1,245	989-1,625	1,191	684-1,539	-0.32	-0.50-0.04	-0.36	-0.73-0.10
	P9	1,814	1,413-2,001	1,853	1,586-2,043	-0.04	-0.25-0.05	-0.02	-0.16-0.08
	P10	1,590	1,135-1,741	1,561	1,289-1,865	-0.20	-0.53-0.09	-0.22	-0.42-0.00
	P11	1,632	1,442-1,834	1,623	1,224-1,952	-0.18	-0.31-0.04	-0.18	-0.46-0.04
	P12	1,150	878-1,711	1,212	953-1,717	-0.35	-0.51-0.01	-0.31	-0.47-0.01
	P13	1,405	1,044-1,689	1,488	1,099-1,754	-0.06	-0.30-0.14	0.00	-0.27-0.18
	P14	1,309	860-1,723	1,217	1037-1,378	-0.35	-0.68-0.05	-0.42	-0.55-0.30
	P17	1,238	836-1,542	1,269	909-1,658	-0.42	-0.65-0.25	-0.40	-0.61-0.18
	P18	1,196	944-1,504	1,153	904-1,437	-0.56	-0.73-0.35	-0.59	-0.76-0.40
	P20	1,127	966-1,313	1,283	1,057-1,632	-0.51	-0.62-0.39	-0.41	-0.56-0.19
	P21	1,704	1,310-1,993	1,538	954-2,015	-0.07	-0.33-0.11	-0.18	-0.55-0.13
	P23	1,108	995-1,176	1,243	857-1,489	-0.37	-0.43-0.33	-0.30	-0.50-0.17
	P24	1,092	901-1,429	1,134	749-1,513	-0.45	-0.55-0.27	-0.43	-0.63-0.22

Table 14: Summary of descriptive results for rhotic segments (number of phonetic tap or trill indicated for phonemic tap and trill contexts, respectively).

Group	Participant	Tap		Trill	
		Time 1	Time 2	Time 1	Time 2
AH	P25	4	1	0	0
	P28	11	9	1	0
	P30	21	11	1	0
	P31	0	1	0	0
	P32	4	8	6	6
	P33	1	0	0	0
	P35	6	4	0	0
	P37	0	0	0	0
	P40	16	11	10	14
	P41	7	4	0	0
	P44	1	3	0	0
	P45	0	1	7	4
SA	P1	13	15	2	0
	P3	4	6	1	3
	P6	9	11	10	2
	P9	10	9	13	9
	P10	9	2	0	0
	P11	5	15	11	10
	P12	3	4	3	6
	P13	7	13	1	6
	P14	4	3	0	0
	P17	7	4	0	0
	P18	13	8	0	0
	P20	7	9	1	1
	P21	1	3	5	4
	P23	1	0	0	0
	P24	0	9	0	1

Table 15: Summary of background characteristics by individual.

Group	Participant	Proficiency score at Time 1	PAI score at Time 1	Number of years studying Spanish	Previous study abroad experience?
AH	P25	18	36	3	No
	P28	7	54	5	No
	P30	11	43	4	No
	P31	11	50	6	Yes
	P32	17	40	3	Yes
	P33	15	38	6	Yes
	P35	8	41	7	No
	P37	13	36	3	No
	P40	12	51	5	No
	P41	12	46	9	Yes
	P44	9	41	5	No
	P45	17	48	2	No
SA	P1	18	46	3	No
	P3	13	46	9	No
	P6	17	52	5	No
	P9	16	55	8	No
	P10	10	44	8	No
	P11	17	46	6	No
	P12	9	47	12	No
	P13	15	56	2	Yes
	P14	8	52	5	Yes
	P17	12	48	3	No
	P18	20	46	3	No
	P20	14	55	5	Yes
	P21	14	52	2	No
	P23	15	43	6	No
	P24	10	42	6	No

Note: PAI = Pronunciation Attitude Inventory (Elliott 1995).

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