VOWEL DURATION IN SECOND LANGUAGE SPANISH VOWELS: STUDY ABROAD VERSUS AT-HOME LEARNERS

John J. Stevens
University of North Carolina Wilmington

This investigation addresses the question of whether immersion in a second language (L2) environment facilitates the acquisition of Spanish pronunciation, as measured in terms of vowel duration, by adult speakers of American English learning Spanish in a study abroad context. Acoustic analysis of recorded speech data found that, whereas study abroad learners showed improvement in their pronunciation of the Spanish vowels, learners studying "at home" in an American university setting did not. A variable rule analysis of the data identified certain factors that predicted phonological gains: For the at-home learners, these were prosodic stress and years of formal Spanish language instruction; for the study abroad learners, these were vowel phoneme, stress, exposure to Spanish television, and use of spoken English.

INTRODUCTION

For native, or first language (L1), speakers of English learning Spanish as a second language (L2), the pronunciation of Spanish vowels can prove particularly challenging given the differences between this class of sounds in both languages. Although interference from English can contribute to a non-native accent for L2 learners of Spanish and may even impede communication, relatively few studies have focused on the acquisition of Spanish vowels by L1 English speakers. The present article addresses the need for further research in this area of L2 Spanish phonology, exploring the relationship between second language acquisition and the environment by comparing the vowel production in terms of duration of a group of students participating in a four-week summer study abroad (SA) program in Spain with that of students learning Spanish "at home" (AH) in an American university setting. Through the qualitative and quantitative analysis of L2 Spanish phonetic data, this investigation examines the variability inherent in the interlanguage phonology of these learners. Variable rule analysis is used to describe this variation in probabilistic terms and to identify certain linguistic, contextual, and social factors that may play a role in promoting a more native-like pronunciation of Spanish vowels.

Vowels in Spanish and American English

Linguists identify five vowel phonemes for Spanish: /i u e o a/ (Navarro Tomás, 1966; Quilis & Fernández, 1979; Schwegler, Kempff, & Ameal-Guerra, 2010). These vowels are reported to be fairly constant across dialects, and it is mainly consonantal variation that accounts for dialectal differences in Spanish. In contrast, American English vowel systems are more complex and less stable. Regional varieties of American English are typically distinguished on the basis of variations in the pronunciation of vowels, not consonants (Dalbor, 1997; Hammond, 2001).

The 11 vowel phonemes typical of much of American speech have no true equivalents in Spanish. Whereas Spanish has five tense vowels, American English shows an opposition between vowels that are tense--/i u e o A/--and those that are lax--/I Y E ℘ Θ/. The five simple or "pure" Spanish vowels are pronounced as true monophthongs. The American English tense vowels /i u e o/ are relatively less tense than their Spanish counterparts and diphthongize respectively to [ii9 uu9 ei9 ou9] in stressed syllables. Although the duration of Spanish vowels in stressed syllables tends to be longer than in unstressed syllables (Marín Gálvez, 1994; Navarro Tomás, 1916, 1917), this difference is much greater between American English stressed and unstressed vowels (Hammond, 2001), where the latter systematically undergo a process of centralization and reduction to the mid central lax allophone [↔] known as *schwa*.[1]

In order to achieve a more native-like pronunciation of Spanish, American English speakers need to be aware of the differences outlined above. Specifically, they must keep their Spanish vowels short and tense in both stressed and unstressed syllables and avoid the English phonological process that reduces and centralizes unstressed vowels to [↔]. Schwa reduction not only contributes to a foreign accent in Spanish, but has the potential to create confusion among interlocutors by neutralizing gender distinctions in nouns and adjectives and person distinctions in verbs. For example, barring appropriate context, a listener who hears the word *amigo* [friend] pronounced as *[a.mí.⊗↔] cannot be sure if it is a male or female that is being referenced; likewise, the reduced schwa vowel in *[kó.m↔] < *comer* [to eat] leaves unclear whether the subject of the verb is 'I' or 'he, she, you, or it.' American English speakers must also refrain from diphthongizing the four non-low vowels of Spanish /i u e o/ in stressed syllables, because the addition of a glide gives the impression of vowel segments that are excessively long for native Spanish.

Acquisition of Spanish Vowels by L1 Speakers of English

Given the importance of accurate vowel pronunciation in achieving a native or native-like accent in L2 Spanish, it is somewhat surprising that, to date, only a handful of studies have addressed the acquisition of Spanish vowels by L1 speakers of English. In an early contrastive analysis of the English and Spanish sound systems, Stockwell and Bowen (1965) predicted that unstressed vowels would be the most problematic for English-speaking learners of Spanish because English vowels typically reduce to [↔] in unstressed syllables while Spanish vowels never do. Hammerly (1982), in the first empirical study of the acquisition of L2 Spanish vowels, later tested the accuracy of contrastive analysis in order to predict a hierarchy for the persistence of phonological errors. He reported relatively high rates of English transfer in first-semester university learners of Spanish, who frequently diphthongized the Spanish monophthongs /e/ and /o/ respectively to [eI9] and [oY9][2] in stressed syllables and reduced Spanish vowels to [↔] in unstressed syllables. Elliott (1997), in an investigation that evaluated the success of formal instruction in L2 Spanish pronunciation among third-semester university learners, found that explicit teaching of pronunciation had a slight beneficial effect on the improvement of vowels as a whole; however, learners continued to struggle with persistent problems of lengthening, diphthongization of mid vowels, and schwa reduction.

More recently, Menke and Face (2010) set out to confirm previous accounts of L2 Spanish vowel acquisition by providing a study that employed spectrographic analysis to compare the acoustic qualities of the Spanish vowel productions of intermediate and advanced learners with those of native speakers. The results showed that, while intermediate learners experienced difficulty with producing Spanish vowels, more advanced learners produced vowels with acoustic properties similar to those of native speakers. Nevertheless, all learners showed a tendency toward centralization/reduction in unstressed vowels, thus confirming previous theoretical and impressionistic accounts of the influence of English on L2 Spanish vowels (e.g., Elliott, 1997; Hammerly, 1982; Simões, 1996; Stockwell & Bowen, 1965).

In the only study to date of the perception of Spanish vowels by L2 learners, García de las Bayonas (2004) found that the perception of Spanish vowels by intermediate English-speaking learners was similar to that of native Spanish speakers. This finding suggests that the accurate perception of Spanish vowels may not be as difficult for learners as reducing the influence of English lengthening, diphthongization, and schwa reduction on their pronunciation of Spanish vowels.

Acquisition of L2 Spanish in a SA Context

The effect of SA on the acquisition of L2 Spanish by native English speakers is not entirely clear. Although many comparative studies have found that SA learners show more gains in language proficiency compared to AH classroom learners in overall fluency (DeKeyser, 1986; Segalowitz & Freed, 2004), grammatical abilities (Isabelli & Nishida, 2005), lexical development (DeKeyser, 1986), narrative abilities (Collentine, 2004), and discourse strategies (Lafford, 1995, 2004), some studies have reported AH learners to be equal or better than their SA counterparts in the development of communication strategies (DeKeyser, 1991), pragmatic skills (Rodríguez, 2001), and grammar (Collentine, 2004; DeKeyser, 1986, 1991; Torres, 2003).[3] According to Lafford (2006), these mixed findings may be the result of the wide variety of methodological design employed in these studies, as well as the interaction of cognitive and social factors in the acquisition of L2 Spanish in AH and SA contexts.

The few SA investigations that have focused on the acquisition of L2 Spanish phonology by native speakers of English have generally shown an advantage for SA learners over AH learners. For example, Stevens (2001) found that, while advanced learners studying in Madrid significantly improved their pronunciation of the Spanish voiceless stops /p t k/ in terms of reduced aspiration, a control group of AH learners did not. In addition, this study reported a positive correlation between amount of time spent abroad and greater L2 pronunciation accuracy. In a study that examined the acquisition of Spanish consonantal segments by beginning-advanced learners, Díaz-Campos (2004) found no striking differences in the acquisition of initial voiceless stops, intervocalic voiced fricatives, word-final lateral /l/, and the palatal nasal between AH and SA learners. Nevertheless, in a follow-up study, Díaz-Campos (2006) did find that, with the exception of the intervocalic voiced fricatives, SA learners tended to outperform AH learners in target-like pronunciation of these consonants in a conversational style.

In the only investigation to date to examine the acquisition of L2 Spanish vowels in a SA context, Simões (1996) performed an acoustic analysis of oral interview data (without an AH control group) from five intermediate-advanced adult speakers of American English studying in Costa Rica. Although two learners improved their pronunciation of Spanish vowels, Simões reported that, overall, learners continued to show a tendency toward vowel reduction/centralization.

In sum, the few studies of L2 Spanish vowel acquisition, due to their wide variety of research designs and methodologies, present an incomplete picture of the acquisition of Spanish vowels, especially in a SA context. The present study addresses the need for more research in this area by examining the impact of SA on the pronunciation of Spanish vowels by American English-speaking learners. Specifically, this study investigates whether SA learners, given their greater exposure to the target language (TL), make more gains in acquiring a native-like pronunciation of Spanish in terms of reduced vowel length than do
AH learners. In addition, other factors, such as sex, years of formal instruction, use of spoken Spanish outside of class, etc., are evaluated to see what effect, if any, they have on more accurate vowel production. The research questions to be addressed are the following:

- What effect does SA have on the improvement of L2 Spanish vowel pronunciation in terms of reduced duration?

- What other factors positively influence more native-like pronunciation of Spanish vowels?

METHOD

Participants

The subjects for this study were 22 native speakers of American English from the University of North Carolina Wilmington (UNCW) enrolled in a four-week third-semester Spanish language summer school course. Eleven of the subjects (four males, seven females) studied at UNCW's home campus, and 11 (six males, five females) took the course as part of the university's summer SA program in Úbeda, Spain. The instructor for the AH learners was a near-native speaker of Spanish; the instructor for the SA learners was a native speaker of Latin American Spanish. Both instructors followed the same syllabus and employed a communicative methodology. None of the participants reported knowing, or having studied, another language besides Spanish, and all denied having received any specific instruction in Spanish pronunciation. The amount of previous formal instruction in Spanish was similar for the two groups, averaging 4 years for the AH subjects and 3 years for the SA learners. Their ages ranged from 19 to 27 years. To ensure that all L2 learners were at the same level of language proficiency in Spanish prior to beginning the experiment, the author conducted an interview based on ACTFL's Oral Proficiency Interview (OPI) with each prospective subject.[4] Only subjects found to be at the novice high to intermediate low levels of proficiency according to ACTFL criteria were admitted to the study.[5] Six native speakers of Spanish from Úbeda--three males and three females--also participated in this study in order to establish target norms for the duration of Spanish vowels. These participants ranged in age from 22 to 51, were not university educated, and denied knowing other languages, including English.

Instruments and Procedure

Prior to beginning the experiment, the SA and AH subjects completed a questionnaire adapted from the Language Contact Profile (Freed, Dewey, Segalowitz, & Halter, 2004) that elicited background information regarding L1, amount of contact with other languages, when formal instruction in Spanish began, number of years of formal Spanish study, etc. The AH learners completed a second questionnaire at the end of their program that gathered data regarding their use of spoken Spanish outside of class during the summer session. The SA learners likewise completed a questionnaire at the end of their program that elicited information regarding their use of spoken Spanish and English while in Spain and their amount of exposure to Spanish media (e.g., Spanish cinema, television, and radio).

Sample recordings of the subjects' pronunciation of Spanish while reading a randomized list of sentences were taken from both a pretest and a posttest. The elicitation instrument included 40 randomized target words containing four occurrences each of the five Spanish vowels in both stressed and unstressed syllables in absolute word-final position. The sentence reading task elicited eight tokens of each vowel, rendering a total of 40 tokens per individual for each test. The pretest was administered to the AH subjects during the first week of instruction. The SA subjects took the pretest just prior to departure for Spain. The L2 Spanish learners were then tested a second time during the final week of their respective summer programs. To obtain norms for Spanish vowel duration, it was only necessary to record the Úbeda native Spanish speakers once performing the reading task.

Acoustic Analysis

The phonetic data were digitized, and an acoustic analysis was performed using the Speech Analyzer computer software program. Waveforms and spectrograms were generated for each token. The duration of each sentence-final vowel was measured beginning with the onset of vocal-fold vibration and ending with the final glottal pulse. To avoid the possible effect on duration of contextual factors such as number of syllables and following consonantal segment, all vowel tokens appeared in two-syllable words in absolute final position.[6] To ensure a measure of consistency in the rate of speech, all subjects were instructed to read at a normal speed. A total of 2000 vowel tokens were produced by the subjects. Of these, 31 learner tokens and 6 native speaker tokens were excluded from the analysis, either because subjects substituted a different vowel (e.g., *cas**i*** **>** *cas**e**),* reduced a vowel to schwa (e.g., *mot**o*** > [mó.t↔]), pronounced an unstressed vowel with stress (e.g., *mat**o*** > [ma.tó]), failed to stress an accented vowel (e.g., *pap**á*** > [pá.pa]), or else produced a segment that was inaudible. Reliability of duration measurement was assessed by generating a second set of waveforms and spectrograms for each of the five vowels produced by 10 randomly selected subjects. The duration values of these 50 vocalic segments were measured and compared to the values of the original waveforms/spectrograms. The mean difference between the two sets of measurements was minimal, averaging 5.5 ms, with a range of 0.0 to 9.0 ms.

Quantitative Analysis

Statistical analyses of the data were conducted using the one-way analysis of variance, or ANOVA test, provided by SPSS v. 16.0 software in order to compare the duration values of the Spanish vowels of the AH and SA learners at the outset of the experimental period. Follow-up tests were carried out to determine whether there were significant differences between these groups and if their vowel duration values were significantly different from those of the Spanish native speakers. ANOVA tests were also conducted to see if the AH and SA groups had significantly reduced the mean duration of their Spanish vowels between the pretest and the posttest.

Variable Rule Analysis

In order to evaluate the effect certain linguistic and social factors may have on the pronunciation accuracy of L2 Spanish vowels, the data were coded for variable rule analysis as performed by the multiple regression application known as GoldVarb (Sankoff, Tagliamonte, & Smith, 2005). GoldVarb provides a method for modeling interlanguage variation in a quantitative way by determining the probabilistic weight that social factors such as sex, or linguistic factors such as prosodic stress, contribute to the operation of a particular variable rule. This allows the researcher to make predictions about the likelihood of co-occurrence of any given contextual factor and the linguistic variable under investigation.[7]

In the present study, GoldVarb was used to create a model of the variation in the L2 learners' interlanguage phonology and measure the effect that certain factors may exert, if any, on the accurate pronunciation of Spanish vowels in terms of their duration. In order to evaluate differences between the AH and SA subjects, separate analyses were conducted for each group using the phonetic data obtained at the end of the treatment period. The dependent variable used in both analyses was the same and was coded in binary terms of "accurate" or "inaccurate" pronunciation, depending on whether or not the duration of the token fell within the native Spanish range established for each vowel. The maximum duration ranges used here were based on those observed for the native Spanish informants from Úbeda: 155 ms for /i/, 161 ms for /u/, 174 ms for /e/, 166 ms for /o/, and 195 for /a/. The application value selected was accurate pronunciation. The independent variables considered in the analysis of the AH learners were sex (male, female), vowel (/i u e o a/), stress (stressed, unstressed), years of formal Spanish language instruction (0-3 years, 4 or more years), when formal Spanish instruction began (elementary school, junior high school, high school, university), and use of spoken Spanish outside of class (less frequent = 0-3 hours per week, more frequent = 4 or more hours per week). The same independent variables of sex, vowel, stress, years of formal Spanish language instruction, and when formal Spanish instruction began were used in the GoldVarb analysis of the SA subjects. The variable use of spoken Spanish outside of class was also considered, but the variants were changed to reflect the potential increase in use of the TL in the SA context (less frequent = 0-10 hours per week, more frequent = 11 or more hours per week). Two additional variables were included to evaluate the effect of the learners' behavior specifically within the SA milieu: use of spoken English while in Spain (less frequent = 0-10 hours per week, more frequent = 11 or more hours per week) and exposure to Spanish television outside of class (less frequent = 0-10 hours per week, more frequent = 11 or more hours per week).[8]

RESULTS AND DISCUSSION

Figure 1 shows the mean duration values of Spanish vowels for the AH and SA learners on the pretest and compares them to the duration values of the native speakers. The data here exhibit a pattern noted by other researchers who have observed a correlation between vowel height (openness) and duration, such that high vowels tend to be longer than low ones (e.g. Delattre, 1965; Marín Gálvez, 1995; Monroy Casas, 1980; Navarro Tomás, 1916).[9] At the same time, the learner vowels are clearly longer than the corresponding native speaker vowels. Overall the mean vowel duration was

242 ms (*SD* = 56.48) for the AH learners, 244 ms (*SD* = 45.02) for the SA learners, and 139 ms (*SD* = 31.47) for the native speakers. An ANOVA test was conducted to see if there were significant differences between the mean duration values of the three groups. For this test, the independent variable was the group factor and the dependent variable was vowel duration. The ANOVA proved significant, $F(2, 1183) = 473.45$, $p < .001$. Follow-up tests revealed that, whereas the differences in the means between both learner groups and the native speakers were significant at the $p \leq .05$ level, the difference in the means between the AH and SA learners was nonsignificant.[10] Separate ANOVA tests along with post hoc pairwise comparisons were run to assess differences in the mean duration values of the individual vowels between the groups. All vowels, for both groups of learners, had duration values that proved to be significantly longer than those of the native speakers. In contrast, there were no significant differences found in the mean duration values between the AH and SA subjects for any of the vowels (see Appendix for complete results of these tests). These data show that at the outset of the experimental period, the vowels of the learner groups were markedly longer than the corresponding vowels of the native speakers. The fact that no significant differences were found between the AH and SA learners, either in overall vowel duration or in the length of individual vowels, confirms the suitability of the two groups for comparison.

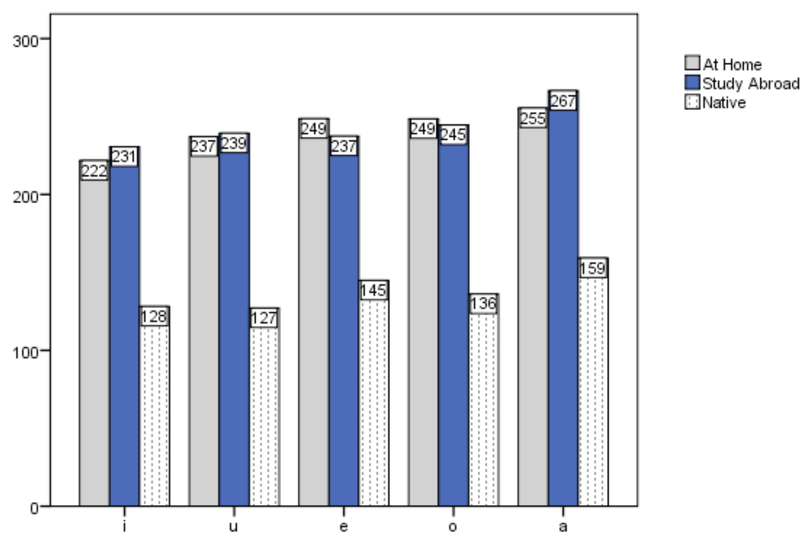

Figure 1. Mean vowel duration values (in ms) for AH learners, SA learners, and native speakers.

The differences in mean vowel duration between the pretest and the posttest for the AH learners are shown in Figure 2. Surprisingly, the mean overall vowel duration for the group, 248 ms (*SD* = 52.41), was longer at the time of the second recording. An ANOVA test was conducted to see if this increase was significant. For this test, the independent variable was time of testing (pretest/posttest) and the dependent variable was vowel duration. The ANOVA revealed that the overall difference in length between the pretest and the posttest was nonsignificant, $F(1, 949) = 3.53$, $p = .06$. Separate ANOVA tests conducted for each vowel showed that the increase in duration was nonsignificant for /u e o a/. The only vowel to show a decrease in duration was /i/, although this reduction was nonsignificant (see Appendix B for complete results). Thus, the AH learners made no real gains in the pronunciation of the target vowels in terms of reduced duration.

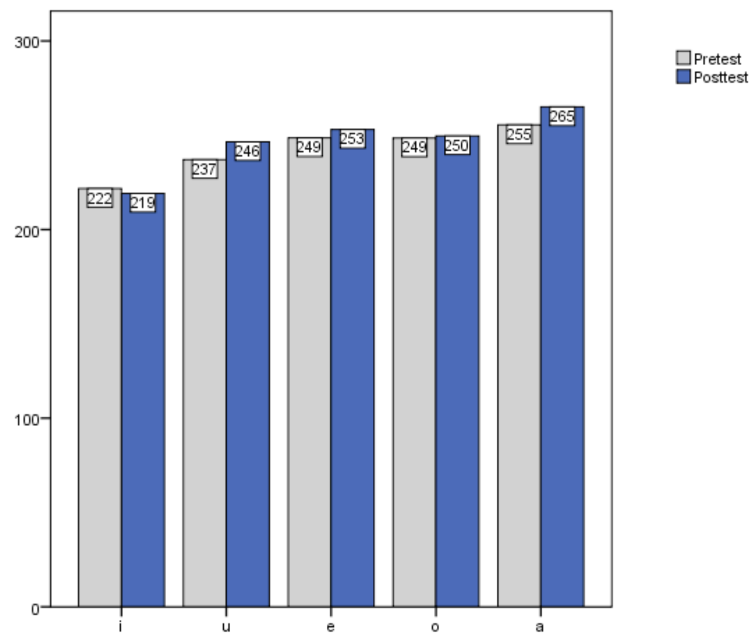

Figure 2: Differences in mean vowel duration (in ms) between pretest and posttest for AH learners

The results for the SA learners are presented graphically in Figure 3. The mean overall vowel duration for the group, 228 ms (*SD* = 52.28), was not as long at the time of the second recording. To see if this reduction was significant, an ANOVA test was performed with time of testing (pretest/posttest) as the independent variable and vowel duration as the dependent

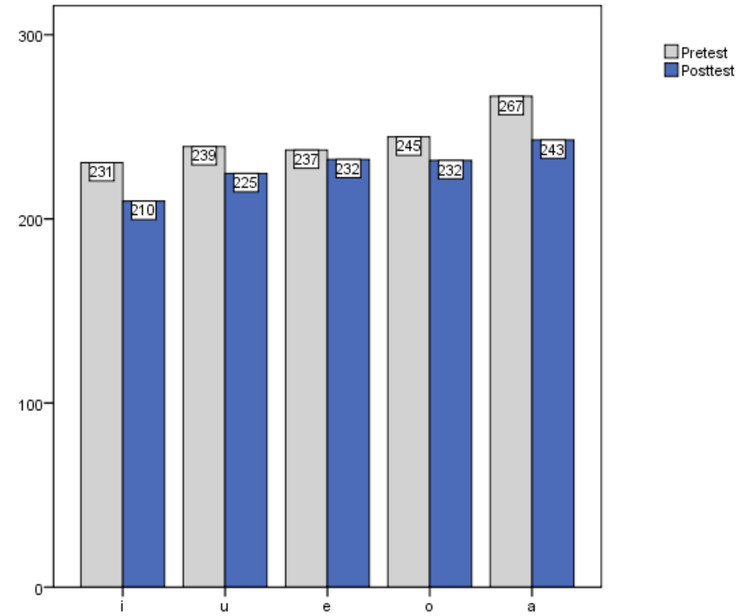

Figure 3: Differences in mean vowel duration (in ms) between pretest and posttest for SA learners.

variable. The ANOVA proved significant, $F(1, 918) = 19.16$, $p < .001$. A series of ANOVA tests performed for the individual vowels showed a significant reduction in duration for /i u a/ and a slight nonsignificant decrease for the mid vowels /e o/ (see Appendix C for complete results). In terms of reduced vowel duration, the SA learners exhibited significant improvement in their pronunciation of the Spanish vowels overall and in the case of /i u a/. Nevertheless, an ANOVA test revealed that the mean vowel duration values overall for the SA learners continued to be significantly longer than those observed for the native speakers, $F(1, 712) = 6.8.55$, $p < .001$. Likewise, ANOVA tests run for the individual vowels indicated that the mean duration values for the SA learners on the posttest continued to be significantly longer than those of the corresponding native speaker vowels (see Appendix D for complete results).

What effect does SA have on the improvement of L2 Spanish vowel pronunciation in terms of reduced duration? The results indicate that, in this case, the SA learners show a clear trend in improvement toward attaining a more native-like pronunciation of the Spanish vowels, while the AH learners do not. Since both groups of learners were at the same general level of L2 Spanish proficiency (novice high-intermediate low), had approximately the same average number of years of formal L2 instruction, and had vowel duration values that were nonsignificantly different from each other at the time of the first recording, the progress in L2 development exhibited by the SA learners appears most likely to be related to context of learning. Although the effect of instructor cannot be completely ruled out, this factor probably does not account for the different outcomes observed here, since the instructor for the AH learners possessed near-native pronunciation in Spanish with vowel duration values falling well within native speaker ranges. Furthermore, both instructors followed the same communicative syllabus and denied explicitly teaching vowel pronunciation.

What is it then about the SA context that led to gains in the acquisition of L2 Spanish pronunciation? According to Krashen, "humans acquire language in only one way--by understanding messages or by receiving *comprehensible input*" (1985, p. 2). Comprehensible input refers to TL that is both meaning-bearing, in the sense that it has a clear communicative intent, and comprehensible, in that learners are able to understand all or most of the intended message. Comprehensible input is the cornerstone of communicative language teaching, which emphasizes appropriate use of language rather than explicit knowledge of language. For Van Patten and Lee (1995), comprehensible input is *the* necessary ingredient in successful second language acquisition because

> features of language, be they grammar, vocabulary, pronunciation, or something else, can only make their way into the learner's mental representation of the language system if they have been linked to some kind of real-world meaning. If the input is incomprehensible or if it is not meaning-bearing, then these form-meaning connections just don't happen (p. 38).

Given the fact that both instructors in this study employed the same communication-based teaching methodology, it is clear that both the AH and SA learners received comprehensible input as part of their regular classroom instruction. However, the immersion environment provided the SA learners with innumerable opportunities to practice the TL outside of the classroom, for example, with host families and their relatives, with Spanish friends, while traveling on excursions, etc. It seems likely that this increased exposure to the TL in communicative situations resulted in the SA learners receiving greater amounts of comprehensible input, which in turn led to gains in the acquisition of L2 pronunciation. In this case then, the increased exposure to the TL, specifically, greater amounts of comprehensible input, afforded by the SA context resulted in improvement in the pronunciation of the Spanish vowels by the SA learners. The AH learners, on the other hand, did not of course enjoy the benefit of the immersion effect of the SA milieu, and therefore experienced no real improvement in the pronunciation of the Spanish vowels in terms of reduced duration.

Variable Rule Model: AH Learners

In order to see what factors may play a role in promoting accurate Spanish pronunciation in the two learning contexts, separate multivariate analyses were conducted for the AH and SA groups using data from the posttest. A variable rule model of accurate Spanish vowel pronunciation for the AH learners is presented in Table 1. This table indicates the independent variables, or factor groups, that the multiple regression program GoldVarb selected as significantly impacting the dependent variable, the pronunciation of the Spanish vowels in binary terms of accurate pronunciation, that is, tokens that fell within native speaker ranges, and inaccurate pronunciation--tokens that exceeded the native speaker ranges (see above). The other factor groups considered in the analysis--sex, vowel, when formal Spanish instruction began, and use of spoken Spanish outside of class--were "thrown out" by the step-up/step-down function in GoldVarb as variables that did not contribute significantly to the variation in the data.

Table 1: Variable Rule Model of Accurate Spanish Vowel Pronunciation for AH Learners

Input probability				.30
Total *N*				429
Factor Group	Factor	Probability	%	*N*
Stress	Unstressed	.68	47	214
	Stressed	.35	22	215
	Range	*33*		
Years of formal Spanish instruction	4+ yrs.	.64	40	236
	0-3 yrs.	.39	28	193
	Range	*25*		

In addition to indicating the factor groups that exert a statistically significant effect at the $p < .05$ level, GoldVarb assigns probability weights to factors within groups: Weights above .50 are thought to favor the application of a particular rule, in this case, the pronunciation of Spanish vowels with native speaker duration values, while weights below .50 are considered to disfavor its application.

As shown in Table 1, the factor group selected as the most significant was stress.[11] Whereas unstressed vowels favored the accurate pronunciation of Spanish vowels, stressed vowels did not. This result is not surprising given the fact that stress correlates with duration in English such that stressed vowels tend to be longer than unstressed vowels. It appears that in this group of novice high-intermediate low learners, interference from the L1 is influencing their interlanguage phonology with the result that unstressed vowels are more likely to fall within the native Spanish duration ranges, while stressed vowels are more likely to exceed these.

The only other variable to be selected by GoldVarb as significant was years of formal Spanish instruction. More accurate vowel pronunciation was favored by learners with 4 or more years of instruction in the TL, while learners with 3 or less years of instruction did not favor accurate pronunciation. This finding suggests that a prolonged period of formal instruction may have a positive impact on attaining a more native-like pronunciation (cf. Díaz-Campos, 2004).

Variable Rule Analysis: SA Learners

A separate variable rule model of accurate Spanish vowel pronunciation was created for the SA subjects using the same dependent variable as above, a binary distinction between accurate and inaccurate pronunciation according to native speaker ranges. The results, presented in Table 2, indicate the independent variables that were found to significantly influence the variability in the SA learners' pronunciation of the Spanish vowels. The remaining factor groups of sex, years of formal Spanish language instruction, when Spanish instruction began, and use of spoken Spanish outside of class were found not to be significant.

In this model, the factor group selected as the most significant was vowel phoneme. While /i u/ favored accurate pronunciation, /o e a/ did not. The results reveal a pattern of decreasing strength on the application of the variable rule: The high vowels /i u/ favored accurate pronunciation; followed by the mid vowels /o e/, which slightly disfavored accurate pronunciation; and finally the low vowel /a/, which strongly disfavored a more native-like pronunciation. According to Delattre (1965), high vowels tend to be longer than mid vowels, which, in turn, are generally longer than low vowels. The fact that high vowels tend to have duration values that are inherently shorter than non-high vowels may explain why /i u/ were found to correlate positively with accurate pronunciation while the non-high vowels did not.
This finding suggests that in the development of the L2 Spanish phonological system, the acquisition of /i u/ may precede that of /o e a/ in terms of vowel duration.

The next most significant factor group selected by GoldVarb was stress, with unstressed vowels promoting accurate pronunciation and stressed vowels disfavoring more accurate pronunciation. This result is similar to that obtained in the variable rule analysis of the AH learners and again suggests that stress may play an important role in the acquisition of L2 Spanish vowels.

The third most important factor group was exposure to Spanish television. Whereas learners who claimed to watch Spanish television more frequently (11 or more hours per week) favored accurate pronunciation, those who reported less frequent exposure (10 or fewer hours per week) disfavored accurate pronunciation. Although none of the subjects reported going to the cinema or having had any regular exposure to Spanish radio, all claimed to have watched at least some Spanish TV in their host family's home. In fact, one student remarked to the author that "the TV was always on, even during meals." The increased amount of TL input provided by watching television, often in the company of members of the host family, appears to have had a beneficial effect on more accurate L2 Spanish pronunciation.

Table 2. Variable Rule Model of Accurate Spanish Vowel Pronunciation for SA Learners

Input probability				.30
Total *N*				435

Factor Group	Factor	Probability	%	*N*
Vowel	/i/	.72	50	88
	/u/	.56	32	87
	/o/	.48	37	86
	/e/	.47	35	87
	/a/	.33	20	87
	Range	*38*		
Stress	Unstressed	.70	52	217
	Stressed	.35	23	218
	Range	*36*		
Exposure to Spanish television	More frequent	.66	46	204
	Less frequent	.36	25	231
	Range	*30*		
Use of spoken English	Less frequent	.71	49	113
	More frequent	.42	29	322
	Range	*29*		

The last significant factor group selected by GoldVarb was use of spoken English while in Spain. Students who reported less frequent use of English (10 or less hours per week) favored accurate pronunciation, while those who admitted to more frequent use of English (11 or more hours per week) did not. A direct correlation between less frequent use of English and more frequent use of Spanish cannot be automatically assumed here; nevertheless, it seems probable that learners who minimized their use of English would have chosen to use the TL instead. This increase in the use of the TL may account then for the finding that learners who used English less frequently favored a more native-like pronunciation. Conversely, learners who opted to use English, for example, while traveling, with fellow students, and even with their host family, would have diminished their opportunities to practice the TL, and this may be responsible for the less accurate pronunciation finding observed here. In light of these results and their possible interpretation, one might wonder why the factor group of use of spoken Spanish outside of class was not selected as contributing significantly to the variability in the data. In this case, it is possible that there may have been a problem regarding self-reported use of Spanish by students who, regretful that they hadn't taken better advantage of the opportunity to speak more Spanish during their stay abroad, claimed to have used the TL more than they actually did. This would explain why the variant of less frequent use of English correlated positively with accurate pronunciation while the variable of use of spoken Spanish was found to be nonsignificant.

CONCLUSION

This study contributes to the on-going research in the the acquisition of L2 Spanish phonology by providing evidence that novice high-intermediate low learners can make gains in attaining a more native-like accent in terms of reduced vowel duration. In this case, SA learners improved their pronunciation of the Spanish vowels, whereas AH learners did not. These different outcomes can be attributed to context of learning. Although the length of SA was relatively short (four weeks), it seems likely that the intensive exposure to native speaker models and the increased opportunities to practice the L2 provided by the immersion setting were responsible for the beneficial effect on the vowel pronunciation of the SA learners. This finding adds to the growing literature that demonstrates a positive connection between immersion and second language acquisition in general and provides further evidence in support of the efficacy of SA for L2 Spanish phonological acquisition in particular.

Despite their gains in pronunciation, the SA learners' vowel length, on average, continued to exceed native speaker norms. Future research should investigate whether adult English-speaking learners can achieve mean vowel duration values similar to those observed for native speakers; and in the case of SA learners, whether there is a positive correlation between length of residency abroad and reduction in the duration of L2 Spanish vowels (cf. Carroll, 1967; Murakawa, 1980; Stevens, 2001). Another question to be examined is whether more advanced language learners in a SA environment enjoy any advantage in acquiring Spanish vowels. Researchers such as Díaz-Campo (2004), Flege and Liu (2001), and MacKay et al. (2001) suggest that amount of formal language instruction can play an important role in acquiring the sounds of an L2. Although no correlation between amount of previous formal instruction and L2 pronunciation accuracy was found for the novice high/intermediate low SA learners in the present study, it would be interesting to investigate what gains in L2 pronunciation truly advanced learners with many years of language study make within a SA milieu.

In regard to factors affecting phonological acquisition, multivariate analysis has revealed that certain independent variables have a positive effect on L2 Spanish vowel pronunciation. For the AH learners, the factors that were found to be statistically significant were stress and years of formal instruction. In the case of the SA learners, the significant factors were vowel phoneme, stress, exposure to Spanish television, and use of spoken English. Future studies should continue to examine these and other variables, such as motivation to attain a native accent, in order to get a clearer picture of those factors that predict success in achieving a more native-like pronunciation of L2 Spanish.

Notes

1. In addition to [↔], some authors include in the inventory of American English vowels the high central lax reduced barred-i allophone [\] (e.g., Dalbor, 1997; Wolfram & Johnson, 1982). For ease of exposition, [↔] will be used here as a cover symbol to represent any unstressed reduced centralized vowel.
2. The symbols [eI9] and [oY9] appear in the original article.
3. For a thorough review of second language acquisition in a SA context, see Freed (1995). For the acquisition of L2 Spanish and SA, see Lafford (2006).
4. The author is trained in administering and scoring the OPI.
5. Thirteen subjects were excluded from the original pool of 35 because they were either non-native speakers of English, had studied another language, had spent an extended period of time in a Spanish-speaking country, or else had a Spanish proficiency level significantly different from that of the other participants as determined by the OPI.
6. Although vowel length may be affected by a following consonant, a preceding consonant appears to have little or no influence on a following vowel (Delattre, 1965; Navarro Tomás, 1916).
7. For a thorough discussion of variable rule analysis and its theoretical assumptions, see Cedergren and Sankoff (1974), Guy (1988), and Young and Bayley (1996).
8. This variable was originally conceived as exposure to Spanish media, which included going to Spanish movies, watching Spanish television and listening to Spanish radio. However, because none of the SA learners reported going to the movies or listening to Spanish radio, this variable was limited to amount of time watching Spanish television.
9. Delattre (1965) refers to English, German, and Spanish; the other studies cited here refer to Spanish only.
10. Levene's Test of Equality of Error Variances indicated that the variances among the three groups were not homogeneous. Therefore, Dunnett's C test, a test that does not assume equal variances among the three groups, was used for all post hoc comparisons reported in this section.
11. The relative strength of significant factor groups is determined by *range*, which is calculated by subtracting the lowest factor weight from the highest factor weight within a factor group (for further details, see Tagliamonte, 2006).

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APPENDIX A

ANOVA Tests with Post Hoc Pairwise Comparisons for Invidual Vowels, by Group

Vowel /i/: ANOVA significant, $F(2, 224) = 89.10$, $p < .001$

Group	*M*	*SD*	AH	SA
AH	222	40.59		
SA	231	55.01	*ns*	
Native	128	31.79	*	*

Vowel /u/: ANOVA significant, $F(2, 239) = 135.01$, $p < .001$

Group	*M*	*SD*	AH	SA
AH	237	43.68		
SA	239	47.40	*ns*	
Native	127	22.64	*	*

Vowel /e/: ANOVA significant, $F(2, 232) = 116.53$, $p < .001$

Group	*M*	*SD*	AH	SA
AH	249	39.71		
SA	237	49.33	*ns*	
Native	145	31.62	*	*

Vowel /o/: ANOVA significant, $F(2, 241) = 94.96$, $p < .001$

Group	*M*	*SD*	AH	SA
AH	249	46.46		
SA	245	64.11	*ns*	

Native	136	29.52	*	*

Vowel /a/: ANOVA significant, $F(2, 235) = 77.01$, $p < .001$

Group	M	SD	AH	SA
AH	255	51.74		
SA	267	58.34	*ns*	
Native	159	30.40	*	*

Note. The abbreviation *ns* indicates non-significant differences between pairs of means. An asterisk (*) indicates significance at the $p \leq .05$ level.

APPENDIX B

ANOVA Tests on the Mean Differences in Vowel Duration Between the Pretest and Posttest for AH Learners, by Vowel

Vowel /i/: ANOVA nonsignificant, $F(1, 182) = .22$, $p = .641$

Time	*M*	*SD*
Pretest	222	40.59
Posttest	219	35.98

Vowel /u/: ANOVA nonsignificant, $F(1, 195) = 2.57$, $p = .111$

Time	*M*	*SD*
Pretest	237	38.77
Posttest	246	43.59

Vowel /e/: ANOVA nonsignificant, $F(1, 186) = .37$, $p = .547$

Time	*M*	*SD*
Pretest	249	39.71
Posttest	253	59.70

Vowel /o/: ANOVA nonsignificant, $F(1, 189) = .02$, $p = .888$

Time	*M*	*SD*
Pretest	249	46.46
Posttest	250	59.07

Vowel /a/: ANOVA nonsignificant, $F(1, 189) = 1.87$, $p = .173$

Time	*M*	*SD*
Pretest	255	51.74
Posttest	265	44.11

APPENDIX C

ANOVA Tests on the Mean Differences in Vowel Duration Between the Pretest and Posttest for SA Learners, by Vowel

Vowel /i/: ANOVA significant, *F*(1, 178) = 7.70, *p* = .006

Time	*M*	*SD*
Pretest	231	55.01
Posttest	210	45.79

Vowel /u/: ANOVA significant, *F*(1, 184) = 4.47, *p* = .036

Time	*M*	*SD*
Pretest	239	47.40
Posttest	225	46.83

Vowel /e/: ANOVA nonsignificant, *F*(1, 174) = .45, *p* = .504

Time	*M*	*SD*
Pretest	237	49.33
Posttest	232	51.24

Vowel /o/: ANOVA nonsignificant, *F*(1, 183) = 2.17, *p* = .143

Time	*M*	*SD*
Pretest	245	64.11
Posttest	232	52.92

Vowel /a/: ANOVA significant, $F(1, 191) = 7.94$, $p = .005$

Time	*M*	*SD*
Pretest	267	58.34
Posttest	243	58.56

APPENDIX D

ANOVA Tests on the Mean Differences in Vowel Duration Between SA Learners on the Posttest and Native Speakers, by Vowel

Vowel /i/: ANOVA significant, $F(1, 137) = 120.78$, $p < .001$

Group	*M*	*SD*
SA	210	45.79
Native	128	31.79

Vowel /u/: ANOVA significant, $F(1, 140) = 185.48$, $p < .001$

Group	*M*	*SD*
SA	225	46.83
Native	127	22.64

Vowel /e/: ANOVA significant, $F(1, 143) = 128.15$, $p < .001$

Group	*M*	*SD*
SA	232	51.24
Native	145	31.62

Vowel /o/: ANOVA significant, $F(1, 142) = 144.18$, $p < .001$

Group	*M*	*SD*
SA	232	52.92
Native	136	29.52

Vowel /a/: ANOVA significant, $F(1, 142) = 86.13$, $p < .001$

Group	*M*	*SD*
SA	243	58.56
Native	159	30.40