

Acquisition of the Spanish Voiced Spirants by Second Language Learners

Timothy L. Face and Mandy R. Menke
University of Minnesota

1. Introduction

The voiced obstruent series /b, d, g/ has articulatory differences in Spanish and English; in addition to differences in Voice Onset Time (VOT), the manner of articulation of the voiced obstruents varies across the two languages. In Spanish, /b, d, g/ are realized as spirants in a variety of contexts (e.g., *hada* is produced as [aða]).¹ Although the contexts in which spirants are produced vary by dialect, spirantization consistently occurs intervocalically across dialects and speech styles.² The intervocalic context is not confined to within the limits of a single lexical item; rather it extends across word boundaries so that phrases such as *una beca* are realized as [unaβeka]). As a result, spirants are produced both within individual words and at word boundaries.

Spirantization may be difficult for native English speakers acquiring Spanish as a second language (L2) since spirants are not allophonic variants of stops in English. Some English pronunciation guides suggest that English speakers do spirantize both voiced and voiceless stops in fast, casual speech (e.g., Brown, 1990; Gimson, 1989), but spirants are much less frequent and primarily an effect of speech style. Unlike Spanish, English speakers tend to maintain an articulatory separation of adjacent words, inserting a glottal stop between contiguous vowel sounds at word boundaries. For example, phrases such as *the apple* are produced as [ðəʔæpəl], not [ðæpəl].

In addition to learning these different allophones, native English speakers acquiring Spanish must also learn the different phonemic contrasts made between some of the voiced obstruents in Spanish and English. English has a phonemic difference between /b/ and /v/, which in written form are represented by two different graphemes, *b* and *v* respectively. In Spanish, both of these graphemes represent the /b/ phoneme, and /v/ does not exist in the Spanish phonemic inventory. Additionally, [d] and [ð] are allophonic variants of /d/ in Spanish whereas in English they form a phonemic contrast exemplified by minimal pair *dare* [deɪ] and *there* [ðeɪ]. English-speaking learners of Spanish must then learn to produce both written *b* and *v* as /b/ in Spanish and that [d] and [ð] are variants of the same sound.

In order to acquire native-like Spanish pronunciation, English speakers must acquire these phonetic, allophonic, and phonemic differences. Elliott (1997) includes [β, ð, γ, v] in a list of sounds that most contribute to a foreign accent³ in Spanish as judged by Spanish instructors, professors, and graduate students, suggesting that the acquisition of the above mentioned differences proves difficult for English-speaking learners of Spanish. Findings from previous research support this view.

¹ Spanish spirants were traditionally known as fricatives (e.g., Navarro Tomás, 1918), but acoustic analyses have shown that they are most often realized as approximants (e.g., Martínez-Celdrán, 1991). In this paper the term spirant will be used to refer to the weakened form, either fricative or approximant, unless otherwise specified.

² Although the degree of closure may correlate with speech style (e.g., more stop or stop-like productions in slow, hyperarticulated speech), spirantization is systematic in Spanish, occurring in both formal and informal speech.

³ Elliott defines foreign accent as “any oral linguistic output that a native Spanish speaker would deem as *sounding* unnatural or nonnative” (p. 98).

2. Previous research

Early contrastive analysis studies suggested that acquisition of voiced spirants were difficult for native English speakers (e.g., Hammerly, 1982; Stockwell & Bowen, 1965), but Zampini (1994) was one of the first studies to directly investigate how native English-speaking L2 learners of Spanish acquire Spanish spirantization. Seventeen second-semester students and 15 fourth-semester students participated in two tasks, which were designed to not only investigate the acquisition of spirants but also explore the effect of speech style on their production. In the first task, designed to elicit an informal speech sample, subjects answered a series of questions, and in the second, they read aloud a passage from a culture text, intended to elicit formal speech. Zampini's data showed that all subjects, second- and fourth-semester students alike, generally failed to produce spirants; spirants appeared in less than 32% of the expected instances. Although fourth-semester subjects did spirantize at slightly higher rates, differences between the two groups of learners were not statistically significant, suggesting that little to no development occurs in this sound class between the second and fourth semester of language study.

Of the three phones, [ð] proved to be the most difficult, with percentages of spirants produced ranging from only 4.67 to 10.18. The voiced, velar obstruent phoneme, /g/, was produced in its spirant form between 7.56% and 23.08% of the time, slightly less than the phoneme /b/, 13.07% to 32.03%. The rate of spirantization was also found to vary according to task type. Statistically higher rates of spirantization were produced in informal speech than in formal speech for both [β] and [ɣ]. Zampini theorizes that the greater focus on communication, as opposed to pronunciation, in the informal, conversational task may favor weakening of particular sounds. She also speculates that orthographic *v* may have played a role in the pronunciation of /b/ by the native English speakers.

In a later study conducted by González-Bueno (1995), intermediate learner subjects produced the spirantized allophones at a higher rate than the subjects in the Zampini study. They were found to produce spirants about half of the time, 51.5%, during ACTFL Oral Proficiency Interviews. The rank order of spirantized allophones by the five learners in her study resemble the results obtained by Zampini (1994); however, learners produced [ɣ] most frequently, producing it in 67.7% of the cases.⁴ [β] was the second most frequently pronounced spirant, produced at a rate of 59.8%, and [ð] was produced the least, in only 26.7% of the cases. Like Zampini (1994), González-Bueno (1995) concludes that phonemic and allophonic differences in English result in interference in Spanish pronunciation.

In a later study designed to consider the influence of formal pronunciation instruction on Spanish pronunciation, Elliott (1997) found that after formal instruction, students in an intermediate Spanish course were able to accurately imitate spirant forms, i.e. [β, ð, ɣ]. However, as student attention shifted from pronunciation to communicating meaning, fewer spirants were produced and more English forms were used, i.e. [b, d, g, v]. Similarly, Díaz-Campos (2004) found that neither the study abroad students nor the students studying in a regular classroom who participated in his study made any gains in intervocalic fricatives.⁵ Overall, student subjects produced spirants when reading aloud a short text in only 13% of the cases. The same group of students in conversation spirantized with greater frequency, but even then produced spirants in only 28% of the cases (Díaz-Campos, 2006).

Each of these studies points to the difficulties L2 learners of Spanish have acquiring the spirantization process. In only one of the studies did subjects spirantize voiced obstruents in more than 50% of the cases (González-Bueno, 1995). Moreover, studies by Zampini (1994) and Díaz-Campos (2006) point to more frequent production of spirantized forms in tasks that are focused less on form and more on communicating meaning. This finding, that learners spirantize more in more

⁴ This percentage must be interpreted with caution as very few contexts presented themselves for the production of [ɣ] during the oral proficiency interviews with the subjects; there were only 55 obligatory contexts for [ɣ] as opposed to 156 for [β] and 137 for [ð].

⁵ Díaz-Campos (2004) does not include [β] but does include [j] in the group of voiced obstruents in this study. No explanation is given as to why [β] is excluded.

conversational tasks, may explain the higher percentages found in González-Bueno (1995) since subjects in this study were focused upon communicating meaning in an Oral Proficiency Interview as opposed to being focused on pronunciation.⁶ Based on these findings, it appears that the L2 Spanish learners in these studies predominantly produce Spanish spirants in the context that favors their production in English, that is, in informal speech.

When explaining their results and the lack of gains made by beginning and intermediate L2 students with respect to this allophonic process in Spanish, the above researchers cite English transfer and the more marked nature of voiced spirants as possible explanations. The role of transfer from a learner's first language to his/her second language is incorporated into many theories of L2 phonological acquisition (c.f., Contrastive Analysis Hypothesis, Ontogeny Model, Speech Learning Model). At an auditory level, English speakers of Spanish may perceive the spirant allophones as stops and subsequently produce them as such. And at the orthographic level, *d* is linked to [d], not [ð], and *v* is tied to [v], not [b], potentially resulting in non-nativelike pronunciations. Major (1987) proposes in his Ontogeny Model that early in the language learning process transfer errors are many, but that over time, they gradually decrease.⁷ This would suggest that more advanced learners would eventually acquire the more native-like spirantized production of intervocalic voiced stops.

Differences in the degree of markedness have also been shown to influence the order of acquisition as well as the degree of relative difficulty with which sounds are acquired by L2 learners (e.g., Carlisle, 1998; Castino, 1991). Eckman (1977) defines markedness in the following way: A phenomenon A is more marked than B if the presence of A in a given language requires the presence of B but the presence of B does not require the presence of A. Since voiced spirants imply the presence of voiced stops, and not vice versa, the spirantized forms are more marked than the stops themselves. Eckman's (1977) Markedness Differential Hypothesis (1977) proposes that areas of the L2 that are different from the L1 and are more marked are difficult for L2 learners (e.g., the voiced spirants in Spanish for native English speakers); the degree of difficulty, however, depends upon the degree of markedness. The degree of difficulty may affect rate of acquisition, but does it affect ultimate attainment?

Because the production of Spanish spirants has only been investigated with beginning and intermediate learners to date, the question of whether advanced learners acquire spirantization remains unanswered. Based on previous findings, it appears that there is little development in the learners' interlanguage with respect to spirantization, but only a short time span is considered. The ability to observe development is further limited by the coding schemes employed in both Zampini (1994) and González-Bueno (1995); learner productions were coded as either correct (spirant) or incorrect. Such a coding scheme prevents description of any changes in pronunciation and identification of any substitutions or approximations that are made in the process of acquiring the native-like form. More information is needed to facilitate accurate description of the learners' interlanguage system.

Additional areas that warrant further investigation are the effect of orthography and the surrounding linguistic context. Although orthography is used to explain different rates of spirantization across the phonemes, researchers have not systematically studied its influence in this context. Other linguistic factors may also potentially explain some of the variation in learner production given that position in the word and stress have been found to affect the magnitude of speech gestures (e.g., Beckman & Edwards, 1994; Beckman, Edwards, & Fletcher, 1992; Browman & Goldstein, 1992; Byrd, 1996; Cole, Hualde, & Iskarous, 1999; Fougeron & Keating, 1996, 1997; Pierrehumbert & Talkin, 1992).

⁶ These researchers cite task formality or style as the difference in rate of spirantization; however, differences in rate may have other explanations. One potential intervening factor is the effect of the written form on pronunciation; given that in each of the studies cited the formal tasks all involved a reading task and the informal tasks were conversational in nature (i.e., no written text was present), the effect of the written form cannot be separated from that of formality.

⁷Developmental errors are also addressed by the Ontogeny Model. It predicts that developmental errors, which are few early in language learning, increase over time before decreasing again later in the language learning process.

This study attempts to tackle some of these potential influences and thus further our understanding of the acquisition of Spanish voiced spirants by native English speakers. Specifically, it addresses four research questions:

- How do learners' productions of Spanish voiced spirants develop over time? How do learners at different levels of Spanish language study produce the Spanish voiced spirants? Is there development between levels?
- What is the effect of orthographic 'v' on learners' productions of intervocalic /b/?
- What is the effect of syllable stress on learner productions of the Spanish voiced spirants?
- What is the effect of position within the word on learner productions of the Spanish voiced spirants?

3. Methodology

3.1. Subjects

A total of 53 native English speakers participated in this study.⁸ All subjects were current L2 learners of Spanish who had no formal Spanish language instruction prior to seventh grade or 12 years of age. Subjects were classified into three groups based upon their level of Spanish instruction: university students enrolled in a fourth-semester Spanish course, graduating Spanish majors, and Ph.D. students in Spanish. There were substantial differences between groups with respect to the amount of time they had been studying Spanish, amount of time spent in a Spanish-speaking country, and time spent using Spanish per week. Learner group descriptions are provided in Table 1. Although there is some overlap between the three groups, there are also clear distinctions. Generally, Ph.D. students have been studying Spanish longer than graduating majors who have been studying Spanish longer than fourth-semester Spanish students. Similarly, Ph.D. students on average have spent much more time abroad than either of the two groups. Fourth-semester students have spent very limited time in Spanish-speaking countries, and those who have, have typically traveled for leisure, not language study. The amount of time using Spanish outside of work/study each week appears to be the most variable feature and the specific numbers may not be reliable as many learners had trouble estimating these amounts. Nonetheless it seems clear that more advanced learners use Spanish more often on a weekly basis. Although no standardized proficiency measures were employed, there are notable differences that differentiate the three groups of Spanish students.

3.2. Tasks

Subjects were asked to complete two tasks. The first was a background questionnaire used to gather important biographical data on each of the student subjects and their experiences learning Spanish. The second task was an oral reading of a Spanish short story. The short story, *Aniversario* by Luis Romero, is an authentic text taken from a literature anthology used in third-year university courses. Reading connected prose falls somewhere near the middle of the interlanguage speech continuum proposed by Tarone (1983); while not a naturalistic task, it allows subjects to immerse themselves in a coherent text, which is less devoid of meaning than a list of words. By eliciting learner productions in this way, the researchers were able to control for the linguistic context while still providing subjects with a meaning-making task. The story was modified slightly in order to have enough instances of specific phonological segments in specific linguistic contexts; modifications generally took the form of changing names or the addition of emotional interjections, such as "*Dios guarde su alma.*" or "*¡Basta ya!*" Subjects were asked to read the story aloud at a normal pace while being recorded using a Marantz digital recorder. Fourth-semester learners typically needed 20-25 minutes to complete the

⁸ Heritage language learners were not included as part of this study. Given that differences often exist in the language learning experiences of heritage learners and more traditional foreign language learners of Spanish, the speech of these two groups was not investigated together. Exploring heritage learners' productions of this problematic sound class constitutes an area for future study.

reading while more advanced learners were able to complete the reading in approximately 10-15 minutes.

Table 1: Learner Group Characteristics

Level	No. of subjects	Years of Spanish study		Time spent in a Spanish-speaking country (in months)		Time spent using Spanish per week ⁹ (in hours)	
		range	average	range	average	range	average
Fourth-semester	20	2-7	5.15	0-1	0.4125	0-6	2.05
Graduating Spanish major	20	5-16	7.95	0-16	6.16	0-27	8.11
Ph.D.	13	8-26	13.1	2-60	15.3	1-54	29.2

3.3. Data Analysis

Tokens were taken from throughout the entire story and represented a variety of linguistic contexts; the same tokens were analyzed for each learner. A total of 50 tokens per subject were analyzed: 15 tokens of /d/, 15 tokens of /g/, 15 tokens of /b/ represented by orthographic *b*, and 5 tokens of /b/ represented by orthographic *v*. Ten of the tokens per phoneme were taken from word-internal positions, 5 from stressed syllables and 5 from unstressed syllables. The remaining five tokens per phoneme were in word-initial position, representing both stressed and unstressed syllables. Three of the 5 /b/ tokens represented by orthographic *v* were word-internal and 2 were word-initial. Any mispronunciations that resulted in the target token not being produced in an intervocalic context were eliminated from analysis.

A spectrographic analysis was carried out on each token using Praat v.4.5.16 signal-processing software. Each production was coded for manner of articulation, specifically whether it was a stop, fricative, approximant, or other.¹⁰ Samples of what was classified as a stop, fricative, and approximate are shown in Figures 1 and 2 below. In Figure 1, the left arrow points toward an approximate production of /d/ in the word *cada*; given that the formants continue through the production of this consonant, albeit with less energy, this is a good example of an approximant. The right arrow in the same figure indicates the release of a closure; the lack of sound energy to the left of the arrow illustrates the closure. This production of the /d/ in *día* exemplifies a stop production. An example of a fricative production of /b/ in *todavía* is highlighted by the arrow in Figure 2; frication is evident at the higher frequencies; formants do not continue through this sound. Finally, any production that could not

⁹ Using Spanish was broken into four activities: speaking Spanish with native or fluent speakers of Spanish, listening to Spanish language television, movies, or music, reading for pleasure, and writing for purposes other than coursework. The value listed in this column is the sum of the amount of time reported for each of the four activities.

¹⁰ Given the focus of this study on manner of articulation, point of articulation was not taken into consideration. In other words, whether the /d/ in *cada* was dental or alveolar was not included in this analysis. In much the same way, pronunciations of orthographic *v* were not analyzed for bilabial or labio-dental point of articulation; only whether the production was a stop, spirant, or fricative was considered.

be classified into one of the three previous categories was classified as other. Among the productions coded as other were deletions, including those in words such as *distráida* /distráia/.¹¹

Figure 1: Spectrogram image of *cada día* by a graduating Spanish major

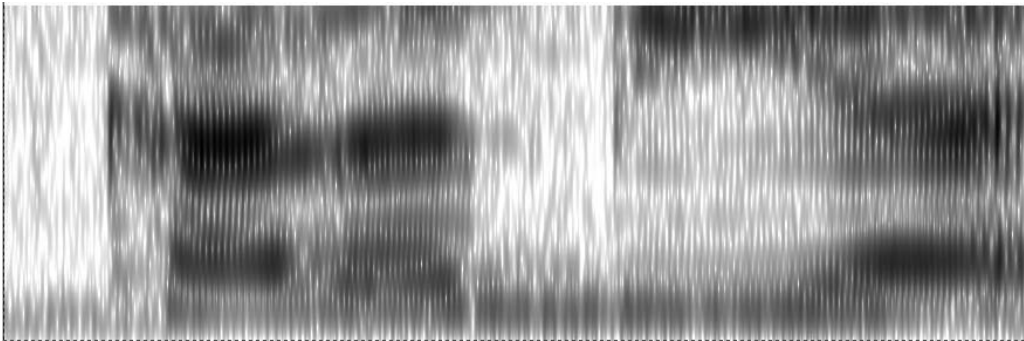
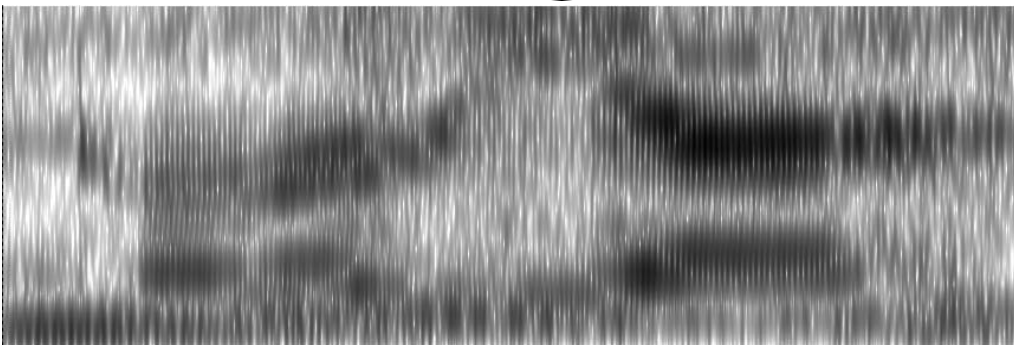


Figure 2: Spectrogram of *todavía* by a graduating Spanish major



4. Results

A total of 2,471 intervocalic productions of /b, d, g/ were analyzed; this represents 93.25% of the collected sample. 179 potential tokens were not considered in the analysis as a result of subjects either deleting the word or mispronouncing the word in such a way that the target token was not produced in an intervocalic context. Results from each learner group will be presented first, followed by results that consider productions according to orthographic *b* and *v*, syllable stress, and finally position in the word.

4.1. Results according to level

4.1.1. Fourth-semester learner productions

Fourth-semester learners produced more tokens as stops than any other manner of articulation; stops were produced in 58.61% of the cases. This trend holds across each individual phoneme as well. As shown in Table 2, fewer tokens of /b/ were produced as stops, 50.82%, than tokens of either /d/ or /g/, 67.32% and 60.2%. Approximants were the second most common manner of articulation, and fricative productions were relatively infrequent, comprising only 4.95% of the total group sample. Very few tokens were coded as other. For both /b/ and /d/, productions coded as other were deletions

¹¹ In an analysis that coded productions as correct or incorrect, these productions would not be considered inaccurate or non-targetlike given the frequent elision of this phone in morphemes such as *-ado* and *-ido* among native speakers.

such [poðio] for *podido*; productions of /g/ coded as other were other sound substitutions. A chi-square test was run to determine the significance of the differences in manner of articulation between phonemes; differences were found to be statistically significant at the $p < 0.01$ level.

Table 2: Fourth semester productions by phoneme

		/b/	/d/	/g/	Totals
Stops	number	186	173	204	521
	percentage	50.82%	67.32%	60.2%	58.61%
Spirant fricative -	number	29	6	18	44
	percentage	7.92%	2.33%	5.3%	4.95%
Spirant approximant –	number	148	74	115	317
	percentage	40.44%	28.79%	33.9%	35.66%
Other	number	3	4	2	7
	percentage	0.82%	1.56%	0.6%	0.79%
Totals		366	257	339	889

$$\chi^2(6)=26.223, p<0.001$$

4.1.2. Graduating Spanish Majors

University Spanish majors in their last semester of studies produced intervocalic /b, d, g/ as approximants in over 50% of the tokens; this trend holds across all three phonemes as shown in Table 3. Stops continue to be produced with some regularity, approximately one-third of the time. Fricatives and other productions are infrequent. Productions coded as other were either deletions or substitutions. More spirant forms are produced in tokens of /b/, followed by /d/ and then /g/. Differences in manner of articulation across the three phonemes were statistically significant at the $p < 0.01$ level.

Table 3: Graduating Spanish Major Productions by Phoneme

		/b/	/d/	/g/	Totals
Stops	number	109	92	111	312
	percentage	28.24%	33.7%	39.64%	34.32%
Spirant fricative -	number	14	11	5	30
	percentage	3.63%	4.03%	1.79%	3.30%
Spirant approximant –	number	262	165	159	556
	percentage	67.88%	60.44%	56.79%	61.17%
Other	number	1	5	5	11
	percentage	0.26%	1.83%	1.79%	1.21%
Totals		386	273	280	909

$$\chi^2(6)=16.980, p=0.009$$

4.1.3. Ph.D. Students

Ph.D. student productions follow the same general pattern as those of the graduating Spanish majors (see Table 4) although approximants are produced with even greater frequency, 81.06%. The /b/ phoneme continues to be produced as an spirant with greater frequency than either of the other two phonemes. Stops are still produced, although with less regularity, and /g/ is produced with greater frequency as a stop than either /b/ and /d/. Other-coded productions were mostly deletions, with the exception of two sound substitutions. Differences in manner of articulation across the three phonemes were statistically significant.

Table 4: Ph.D. Productions by Phoneme

		/b/	/d/	/g/	Totals
Stops	number	32	31	43	106
	percentage	12.4%	16.3%	22.6%	16.59%
Spirant fricative –	number	0	7	2	9
	percentage	0%	3.7%	1.1%	1.41%
Spirant approximant –	number	227	150	141	518
	percentage	87.6%	78.9%	74.2%	81.06%
Other	number	0	2	4	6
	percentage	0%	1.1%	2.1%	0.94%
Totals		259	190	190	639

$$\chi^2(6)=22.413, p<0.001$$

4.1.4. Across-group comparisons

Table 5 collapses the data from the three phonemes together for each group of subjects in order to facilitate comparisons across the three groups. There is a notable increase in the production of approximants, and conversely, a notable decrease in the production of stops as learner level increases. Stops and fricatives are produced by learners at all three levels, but their production decreases as the level of the learner increases. Overall, the relative percentage of spirant production increases across the levels. Differences between learner levels are statistically significant.

Table 5: Overall Production by Learner Level

Production		Fourth-semester	Graduating Spanish Major	Ph.D.
Stop	Number	521	312	106
	Percentage	58.61%	34.32%	16.59%
Spirant Fricative -	Number	44	30	9
	Percentage	4.95%	3.30%	1.41%
Spirant Approximant -	Number	317	556	518
	Percentage	35.66%	61.17%	81.06%
Other	Number	7	11	6
	Percentage	0.79%	1.21%	0.94%
Total		889	909	639

$$\chi^2(6)=341.774, p=0.001$$

4.2. Results of orthographic *b* and *v*

As mentioned in the introductory section, both *b* and *v* represent /b/ in Spanish. It has been suggested that this poses a special challenge for native English speakers learning Spanish as an L2 as they must first disassociate the written *v* from the L1 phoneme /v/ and then associate it with another phoneme, /b/. This is all in addition to acquiring the allophonic spirantization process for voiced obstruents, which includes /b/.

Findings presented in the previous section showed when the two written graphemes, *b* and *v*, are collapsed together, /b/ was the phoneme most often produced as a spirant for all three learner groups. In Table 6, learner productions of the /b/ phoneme are separated according to grapheme. Differences in production between the two graphemes are statistically significant at the $p<0.01$ level for all three subject groups.

Table 6: Learner Productions of *b* and *v*

Production		<i>b</i>			<i>v</i>		
		Fourth semester*	Graduating Spanish majors**	Ph.D.***	Fourth semester	Graduating Spanish majors	Ph.D.
Stop	number	174	101	31	12	8	1
	percentage	64.21%	35.19%	16%	12.63%	8.08%	1.5%
Spirant fricative	number	0	1	0	29	13	0
	percentage	0	0.35%	0	30.53%	13.13%	0
Spirant approxinant	number	94	185	163	54	77	64
	percentage	34.67%	64.46%	84%	56.84%	77.78%	98.5%
Other	number	3	0	0	0	1	0
	percentage	1.11%	0	0	0	1.01%	0
Totals		271	287	194	95	99	65

* $\chi^2(3)= 136.062$, $p < 0.001$, ** $\chi^2(3)= 57.144$, $p < 0.001$, *** $\chi^2(3)= 9.376$, $p = 0.002$

As seen in Table 6, /b/ is produced more often as a stop when represented orthographically as *b* than when represented as *v*. Rates of stop production for *b* alone are very similar to the percentage of /d/ and /g/ tokens produced as stops. For example, fourth-semester subjects produced /d/ and /g/ as stops in 67.32% and 60.2% of the respective cases. When only /b/ tokens with an orthographic *b* are considered in the analysis, the number of stops is very similar, 64.21%. The same trend exists for graduating Spanish majors and Ph.D. students. What is also striking is that *b* is almost never produced as a fricative; only once is orthographic *b* produced as a fricative. This contrasts with the productions of /d/ and /g/, which are both produced as fricatives, albeit infrequently.

Orthographic *v* represents an opposite trend; all learner groups produced tokens with written *v* more often as an approxinant than *b*; moreover, fourth-semester and graduating Spanish major subjects produced *v* as a fricative more often than they did *b*. In fact, rates of fricative production for /b/ when represented orthographically as *v* are more than six times greater than those for /d/ and /g/ for the fourth-semester group and over twice as frequent for the graduating Spanish majors.

All three subject groups differentiate *b* and *v* in their productions; orthographic *b* is produced more often as a stop and orthographic *v* is produced more often in a spirant form, either as a fricative or as an approxinant.

4.3. Results according to linguistic context

The effect of linguistic context on the production of intervocalic voiced obstruents by English-speaking learners of Spanish has to date been uninvestigated. Both syllable stress and word position will be explored in this section.

4.3.1. Production according to syllable stress

The manner of articulation in which each token is produced is presented in Table 7 according to syllable stress. There are notable differences in the pronunciation of stressed and unstressed syllables for both fourth-semester subjects and graduating Spanish majors. More stops were produced in stressed syllables than unstressed syllables for both groups of learners; subsequently, more approximants were produced in unstressed syllables. The differences are significant for the fourth-semester learners but not for the graduating Spanish majors. At the Ph.D. level, subjects produce nearly identical realizations in stressed and unstressed syllables; the differences were not statistically significant.

Table 7: Learner Productions by Syllable Stress

Production		Fourth-semester*		Graduating Spanish Majors**		Ph.D.***	
		stressed	unstressed	stressed	unstressed	stressed	unstressed
Stop	number	297	334	171	141	53	53
	percentage	68.59%	49.12%	39.58%	29.56%	17.15%	16.06%
Spirant fricative	number	24	20	16	14	7	2
	percentage	5.54%	4.39%	3.7%	2.94%	2.27%	0.61%
Spirant approximant	number	111	206	242	314	247	271
	percentage	25.64%	45.18%	56.02%	65.83%	79.94%	82.12%
Other	number	1	6	3	8	2	4
	percentage	0.23%	1.32%	6.9%	1.68%	0.65%	1.21%
Totals		433	456	432	477	309	330

* $\chi^2(3)= 38.524$, $p < 0.001$, ** $\chi^2(3)= 8.171$, $p=0.043$, *** $\chi^2(3)= 3.870$, $p=0.276$

4.3.2. Production according to word position

Findings related to the manner of articulation with which learners produced each token are presented in Table 8 according to whether the target phone was in word-initial or word-internal position. Across all three levels, more spirants are produced word-internally than word-initially. Fourth-semester subjects produce spirant forms in approximately 20% of the tokens in word-initial position; when the voiced obstruent is word-internal, however, spirant forms are produced over twice as often, 49.60% of the time. The same pattern holds across the other two levels. Although more approximants are produced in word-initial position at both the graduating Spanish major and Ph.D. level than at the fourth-semester level, there are also more approximants produced word internally indicating an overall increase in approximant production rather than improvement in word-initial position. The difference between the two word positions is thus maintained at all three learner levels.

5. Discussion

5.1. How do learners' productions of Spanish voiced spirants develop?

In the results presented above, it was shown that stops account for a majority of fourth-semester learners' productions for all three phonemes. Looked at from the perspective of spirantization, this means that these students spirantize intervocalic obstruents less than half the time. The rate found in this study, 40.61%, is higher than that found by Zampini (1994) but comparable to that found by González-Bueno (1995). According to Zampini (1994), it appeared that learners spirantized /b/ with the greatest frequency, followed closely by /g/; /d/ was spirantized the least. The same order was found in this study for fourth-semester learners, but the findings of the influence of orthography on learner production, especially at the fourth-semester level, suggest that higher rates of spirantization for /b/ may be an artifact of fricative productions of orthographic *v* due to the influence of English.

Previous studies reported little growth in the rates of spirantization; however, they only compared students' pronunciations over the course of a semester (Díaz-Campos, 2004) or two semesters (Zampini, 1994). By looking beyond the intermediate learner level, to graduating Spanish majors, it becomes apparent that learners do begin to spirantize with greater frequency. Unlike the fourth-semester students, the graduating Spanish majors in this study produced spirants in approximately 65% of the tokens, and even more advanced learners such as Ph.D. students spirantize in approximately 80% of potential contexts. Therefore, it can be stated that with respect to intervocalic spirants, the interlanguage system of English-speaking learners of Spanish does show development. Also, it is important to note that English learners of Spanish tend to produce approximants rather than fricatives; in fact, the percentage of fricatives produced decreases across learner group levels. Previously reported findings from native Spanish speakers suggest that spirants are realized as approximants (e.g.,

Martínez-Celdrán, 1991) and that spirantization occurs categorically; thus, it seems that learners do make significant progress in moving toward native speaker norms.

Table 8: Learner Productions by Word Position

Production		Fourth-semester*		Graduating Spanish Major**		Ph.D.***	
		Word Internal	Word Initial	Word Internal	Word Initial	Word Internal	Word Initial
Stop	number	308	213	166	168	50	56
	percentage	49.44%	80.08%	23.25%	61.09%	11.79%	26%
Spirant fricative –	number	30	14	29	8	8	1
	percentage	4.82%	5.26%	4.06%	2.91%	1.89%	0.5%
Spirant approximant –	number	279	38	507	99	362	156
	percentage	44.78%	14.29%	71.01%	36.0%	85.38%	72.6%
Other	number	6	1	12	0	4	2
	percentage	0.96%	0.38%	1.68%	0%	0.94%	0.9%
Totals		623	266	714	275	424	215

* $\chi^2(3)= 71.862$, $p<0.001$; ** $\chi^2(3)= 99.164$, $p<0.001$; *** $\chi^2(3)= 22.413$, $p<0.001$

Across all three levels, /b/ is spirantized by learners more than either /d/ or /g/. González-Bueno (1995) attributes this to developmental factors given that children learning Spanish as a first language also initially spirantize /b/ more than the other phonemes (Macken & Barton, 1980 cited in González-Bueno, 1995). Zampini (1994), on the other hand, suggests that orthographic influences may be at play, referencing both the Spanish allophone [ð] and grapheme *v*. The next research question specifically addresses the issue of orthographic *b* and *v*.

5.2. What is the effect of orthographic ‘v’ on learners’ productions of intervocalic /b/?

Orthography was found to have a significant effect in this study. This effect can be seen in two different ways. First, orthographic *b* is not produced as a fricative at any level. This result cannot solely be attributed to the low percentages of overall fricative production because both /d/ and /g/ are occasionally produced as fricatives. Given the fact the orthographic *v* is produced as a fricative by these learners, at least those at earlier stages of the learning process, it appears that they try to maintain a distinction between the two graphemes. This is also supported by the fact that orthographic *v* is rarely produced as a stop, much less than orthographic *b* and either of the other two phonemes.

Both the fourth-semester and graduating Spanish major student groups produced orthographic *v* as a fricative with greater frequency than the other phonemes. At the fourth-semester level, *v* is produced as a fricative in approximately 30% of the cases (compared to 4.95% total fricative production, which includes *v*), and at the graduating Spanish major level, it is produced as a fricative approximately 13% of the time (compared to 3.3% total fricative production). Ph.D. students of Spanish do not produce *v* as a fricative; in fact, they almost always produce *v* as an approximant while for *b* several stops are produced. Given the differences in the realizations of *b* and *v*, it appears that orthography does have an effect on English speakers’ production of Spanish spirants even for very advanced learners.

5.3. What is the effect of syllable stress on learner productions of the Spanish voiced spirants?

As shown above, there is a notable difference in pronunciation in stressed and unstressed syllables for fourth-semester learners and graduating Spanish majors. In both cases, more stops are produced in stressed syllables than in unstressed syllables, suggesting that syllable stress hinders spirantization for these L2 learners of Spanish. The productions of Ph.D. subjects do not appear to be affected by

syllable stress in the same way; the manner of articulation is consistent for this learner group across the two syllable types. This difference between the less advanced groups and the most advanced group indicates that with greater experience, spirantization becomes more categorical and is no longer affected by syllable stress.

5.4. What is the effect of position within the word on learner productions of the Spanish voiced spirants?

The pronunciations of intervocalic /b, d, g/ of all three groups vary according to the position within the word. All three groups of learners produce more spirants when /b, d, g/ occur word-internally than word-initially. Although the relative frequency with which spirants are produced word-initially increases across levels, so does the frequency with which they are produced word-internally. In other words, the movement toward native-like productions affects both positions and the difference between the positions thus remains. The fact that more approximants are produced in word-internal position than word-initial position suggests that learners do not link words together across word boundaries, and as a result, their pronunciation of /b, d, g/ in this context does not reflect the intervocalic context in which it actually occurs. The treatment of each lexical item as an independent unit, as opposed to a connected stream of sounds, may transfer from English or it may be an artifact of fluency. Another possible explanation for the greater rate of spirantization within a word is that of consistency in the input; learners consistently hear /b, d, g/ pronounced as [β, ð, γ] when in word-internal position given that the surrounding linguistic context does not change, but in word-initial position, input to learners may be less regular given that the production depends upon the preceding sound. While this particular study cannot explain the cause these results show that English learners of Spanish do not spirantize across word boundaries as regularly as within the context of an individual word.

6. Conclusions

Previous research into the acquisition of Spanish voiced spirants by native English speakers suggested that English learners of Spanish did not produce spirants in the vast majority of expected contexts. Low rates of spirantization and little development over time were reported. Given that these studies included only beginning and intermediate learners, and that development was only considered over a one- or two-semester time period, few generalizations about development over extended periods of time, and potentially ultimate attainment, could be made. The findings from this study begin to complete the picture of how learner productions of Spanish spirants develop. By including more advanced learners, we have been able to show that there is development of the interlanguage system, and that advanced learners do move toward the native speaker phonetic norm of spirantization of voiced obstruents in intervocalic contexts. While the low rates of spirantization produced by the fourth-semester learners support the findings from previous research, more advanced learners produced spirants regularly, in over 80% of the expected contexts in the case of Ph.D. students, indicating a change in the system of fourth-semester learners and Ph.D. students. Statistically significant differences were found across the three learner groups in the manner of articulation, and this points to development in the interlanguage phonological system and acquisition of Spanish spirants.

In addition, while previous studies addressed the effect of task type or speech style on learner productions, they did not systematically address the effect of orthography or linguistic context. Zampini (1994) and González-Bueno (1995) alluded to the potential influence of orthography, but their study design did not allow for any generalizations to be drawn about its influence. The purposeful inclusion of tokens with different orthographic representations, from both stressed and unstressed syllables, and from different positions within the word allowed us to shed light on the effect of orthography and linguistic context. It was found that learners at all levels maintain a distinction between orthographic *b* and *v*; English transfer appears to prevent the production of orthographic *v* as a

stop and *b* as a fricative. This suggests that orthography does indeed influence how voiced obstruents are pronounced intervocalically.

Furthermore, learner pronunciations in this study were found to differ according to syllable stress and word position. Syllable stress played a role in learner productions at beginning levels as spirants were produced more frequently in less prominent syllables. At more advanced levels, the difference between productions in stressed syllables and those in unstressed syllables was less, disappearing completely in the productions of Ph.D. learners. The differential effect of word position, on the other hand, persisted across all three learner levels. All learners produced more spirants in word-internal than in word-initial contexts, suggesting that learners pronounce each word independent of those surrounding it. Although advanced learners produce more spirants word-initially than beginning learners, they continue to produce voiced obstruents as spirants more frequently word-internally than word-initially. Including more advanced learners and controlling for orthography and linguistic context has allowed for the development of a more complete description of the interlanguage phonological system of adult, English learners of Spanish at different levels. Nonetheless, several questions remain to be answered.

While conducting an acoustic analysis of the productions of learners has allowed for description of their interlanguage system, what remains to be addressed is how learner productions are perceived by the native speaker: Do native speakers perceive stop productions as foreign accented? Does the greater production of spirants lead to less accented speech? The question of ultimate attainment, or how native-like English speaking adult learners of Spanish can become in producing the Spanish spirants, also remains unanswered at this point. Although Ph.D. students represent a very advanced learner group, the spirant productions of individuals who have been studying Spanish for longer periods of time or who have spent more time living abroad may differ from those of the Ph.D. learners included in this study. By investigating the productions of such individuals, we may be able to begin to address this issue. Additionally, future studies should incorporate additional sound classes, adopt a longitudinal design, and investigate the relationship between perception and production in order to address rate of acquisition, which is a central tenet of many of the theories used to explain the difficulty posed by this sound class (i.e., markedness, CAH, Ontogeny Model, SLM as explained in the introduction).

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