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Acoustic Analysis of Voiceless Initial Stops in the Speech of Study Abroad and Regular Class Students: Context of Learning as a Variable in Spanish Second Language Acquisition

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1. Introduction

Studies in the area of second language acquisition have pointed out that context of learning is an important factor for predicting subjects' linguistic gain (Armstrong 1981, Brecht 1993a, 1993b; Brecht, Davidson, and Gimsberg 1995, Freed 1995, submitted, Lafford 1995, submitted, Lapkin, Hart, and Swain 1995, Collentine submitted, Díaz-Campos submitted, Lazar submitted, Segalowitz submitted; among others). In general terms, these previous investigations found that students traveling abroad to a country where the target language is spoken return home with a better linguistic command. For instance, Armstrong (1981:85), who analyzes a group of study abroad students of Spanish in a program in Mexico, maintains: "The discussion of achievement in the four skills in chapter 3 pointed out that listening, reading, and writing gains proved to be greater than those which might be normally expected in a full year of traditional language instruction at the high school level." This idea of improvement after a study abroad program is also pointed out by Freed (1995) in her survey of the literature examining linguistic gain in the study abroad context. Nonetheless, she also maintains that what emerges from previous studies is a somewhat a contradictory perspective as far as linguistic benefits are concerned in a study abroad experience. Freed (1995:8) agrees with Ellis (1994) in that formal instruction is an important key aspect for developing proficiency in a second language, especially if the process of learning includes opportunities for natural exposure.

Given these observations regarding the effect of context of learning in the process of language acquisition, one would have to wonder about its effects in the specific case of phonological acquisition. According to some studies focusing on second language phonology, the acquisition of pronunciation is usually affected by the phonological system of the speaker's first language (Archibald 1998, Leather 1999, Suter 1979, Purcell and Suter 1980).

That is, non-native speakers tend to use their first language phonological system when pronouncing a second language. This observation describes, for instance, the tendency of English-speaking learners of Spanish to aspirate voiceless initial stops while pronouncing Spanish words. Several manuals dedicated to Spanish pronunciation (Barrutia and Terrell 1982, Barrutia and Schwieger 1994, among others) point out this phenomenon and provide an articulatory description in which aspiration is defined as an increase of air flow at consonant release when producing /p t k/ word-initially. The purpose of this investigation is to examine acoustically the production of voiceless initial stops in two groups of students in order to determine the impact of context of learning (study abroad vs. the regular language classroom) on the acquisition of these phonemes.

2. Studies examining Voice Onset Time in the speech of second language learners

Voice Onset Time (VOT) is defined as the beginning of vocal-cord vibration following the release of a closure. Specifically, in the case of voiceless stops the VOT is the interval beginning at the release of the stop and ending at the starting point of voicing. There has been some research done to analyze Voice Onset Time (VOT) in the speech of second language speakers (Flege 1987, Flege and Eefting 1987, Flege and Eefting 1988, González-Bueno 1997a, 1997b; Lewis 2001, Lord 2002). Some of these previous studies focus on describing the acquisition of VOT values in different groups of subjects including French-English bilinguals, Spanish monolinguals and Spanish-English bilingual speakers (Flege 1987, Flege and Eefting 1987, and Flege and Eefting 1988), while others study the effect of phonetic instruction in the acquisition of voiceless stops (González-Bueno 1997a and 1997b, Lord 2002).

Flege (1987) examines whether second language speakers are able to approximate their segmental pronunciation to the target language according to what he classifies as "new" and "similar" phones. "New" phones are those that do not have a counterpart in the native language. For example, the French category /y/ does not exist in English. Flege points out that even though /y/ can be realized as an allophone, it cannot be considered a category in English. "Similar" phones are those that have counterpart in the first language. For example, /t/ is a category in both French and English even though there are important differences in terms of VOT.

Flege's (1987) findings indicate that individuals are more likely to acquire a native-like pronunciation of "new" phones than in the case of "similar" phones. In the case of the sound /y/, the "new" phone analyzed, Flege found that native English speakers produced it with slightly lower mean F2 frequencies (1934Hz) than the group of French monolingual (2062Hz). The more experienced native English speakers were more successful than the least experienced speakers in producing /y/ with a F2 value that is very similar to the one produced by native French monolingual speakers. In the category of "similar" phones, Flege included the phones /u/ and word-initial /t/. The values

obtained for /u/ reveal that the two least experienced native English speakers did not produce French /u/ accurately as it was determined by means of the acoustic analysis. The mean F2 found for this group of students was 1630Hz, which according to Flege was a higher value for producing French /u/. On the other hand, experienced native speakers produced French /u/ and English /u/ with very similar F2 values (i.e. 1630 Hz and 1688 Hz, respectively). In the case of /t/, the group with less exposure to French shows VOT values very similar in both French (72 ms) and English (77 ms). The group with moderated experience (i.e. subjects who have spent an average of 1.3 years in France) shows shorter VOT in French (46 ms) than in English (72 ms). The more experienced speakers (i.e. Americans living in France) produced French /t/ with VOT value that was 13 ms shorter in French (43 ms) than in English (56 ms).

Flege and Eefting (1987) examine whether second language learners establish phonetic categories for phones found in a second language, but not in the native language. Specifically, they study the production of /b d g/ and /p t k/ in word-initial position in English and Spanish in the speech of adult and children who are native Spanish speakers and who have learned English at a different age. They also include in their study a perception experiment to observe the threshold for distinguishing /da/ and /ta/ in English. The findings of this research reveal that all groups included in the study produced /p t k/ with a longer VOT in English than in Spanish (see the appendix where the specific values reported by Flege and Eefting are provided). However, the English VOT values are shorter in comparison to the ones produced by native English speakers. The bilingual adults as well as the bilingual children also produced shorter Spanish VOT values in comparison to native Spanish monolingual speakers. Regarding the perceptual task, Flege and Eefting found that adult speakers tended to posit category boundaries at targets with shorter mean values than monolingual speakers of English. Flege and Eefting suggest that these results are an indication that the native Spanish speakers developed phonetic categories for [p^h], [t^h], and [k^h], but such categories do not match the production of /p t k / by native speakers of English because of the Spanish-accented English input received.

Flege and Eefting (1988) study the production of VOT by a group of native English speakers and Spanish speakers. According to the hypothesis of their investigation, second language speakers who accurately produce English stops do so because they have established a separate phonetic category for these segments. They created synthesized stimuli consisting of 16-member continuum ranging from /da/ to /ta/. During each trial, the stimuli were presented two times. Then, subjects were asked to hear and imitate each one of them. The findings of the experiment indicate that bilingual speakers were able to imitate the stimuli presented distinguishing three categories from non-aspirated to aspirated variants (i.e. lead, short-lag, long-lag¹). Flege and Eefting (1988) maintain that this result is an indication that bilingual Spanish speakers who can make the distinction between non-aspirated vs. aspirated variants of /t/

have acquired a phonetic category [t^h] that is used when targeting aspirated /t/ in English.

González-Bueno (1997a) studies the effect of producing aspirated variants of stop consonants such as /k/ in the perception of foreign accent in the speech of native English speakers who are learning Spanish. She created 28 stimuli including 14 non-aspirated productions and 14 aspirated productions of the word *casa* 'house'. The VOT stimuli ranged from 10ms to 75ms. Non-aspirated targets contained a burst of 10ms, while aspirated ones have a burst of 75ms. Eighteen monolingual speakers of Spanish from Seville, Spain, were asked to classify the stimuli as foreign or native accented. The results indicate that stimuli perceived as native have VOT ranging from 15-35ms. Since González-Bueno finds variation in the perception of the native speakers when VOT is manipulated, she suggests that Spanish pronunciation instruction should take into consideration training activities to shorten VOT of stops in order to achieve more native-like values.

González-Bueno (1997b) studies the effect of formal instruction in the acquisition of Spanish stop consonants (i.e. /p t k b d g/). She selected 60 English native speakers, who had an intermediate level of proficiency at the time when the experiment took place. Thirty students were part of the experimental group receiving formal instruction in the pronunciation of Spanish stop consonants, while 30 students were part of the control group. The results in the case of /p/ show that the experimental group decreased VOT values from 62.03 ms to 40.13 ms. The experimental group also show improvement in the case of /t/ and /k/. Speakers decreased VOT values in the production of /t/ from 60.10 ms in the pre-test to 49.87 in the post-test, while VOT values in the production of /k/ decreased from 89.16 ms in the pre-test to 70.89 in the post-test. Even though the González-Buenos' findings reveal that the experimental group showed shorter VOT in the post-test in comparison to the pre-test, the statistical analysis indicates that the difference of VOT found was only significant for /p/ in the group of voiceless stops sounds², while the rest of the targets show a trend of improvement. González-Bueno concludes that her hypothesis, according to which pronunciation can be improved through formal instruction, is partially supported.

Lewis (2001) examines the weakening of /p t k/ in intervocalic position in the speech of speakers from Northern Spain and Central Colombia. This investigation provides a very detailed acoustic analysis of voiceless stops in terms of closure duration, VOT, closure voicing, intensity relative to the neighboring vowels, and the conservation of the release bursts. The independent variables of Lewis's study include speech style, place of articulation, lexical accent, and position in the word. The VOT values provided by this investigation constitute a current reference of the speech production of native Spanish speakers in different speech styles including conversation, reading a text, and reading a list of words. As in the traditional labovian model, these different styles goes from less formal (i.e. conversation) to more formal (i.e. reading a list of words). The VOT values for intervocalic /p t k/ in the speech production

of northern Spain speakers are as follows: 12.61 ms in conversation, 17.15 ms in the text reading task, and 19.60 ms in the list-of-word-reading task. In the case of the Central Colombia speakers, Lewis (2001) reports the following VOT values: 18.94 ms in conversational style, 20.82 in the text reading task, and 22.46 ms in the list-of-word-reading task.

The general results of Lewis (2001) reveal that the independent variables speech style and lexical stress have a strong effect on the values of certain acoustic correlates. In the particular case of VOT, values were shorter in conversational style and in unstressed syllables. Lewis also point out that lenition of intervocalic /p t k/ is more salient in the Northern peninsular Spanish than in the Central Colombian variety of Spanish.

Lord (2002) studies the effect of instruction in the attainment of native-like VOT in the production of Spanish stops by native speakers of English enrolled in a Spanish phonetics class. She included in her experiment 17 native speakers of English enrolled in a Spanish phonetics class; 10 native speakers of Spanish, and a control group composed of 15 native English speakers enrolled in the prerequisite course to the phonetics class. Students attending the phonetics course were provided with a theoretical explanation of the articulation of voiceless stops. Class training also included oral and transcription practice. This traditional training was reinforced by introducing visualization and practice using phonetic computer software. The findings reveal that the experimental group showed some improvement at the end of the semester³. Surprisingly, Lord also found some improvement in the control group. She concludes that explicit instruction; as well as increased input and output in the target language are beneficial. These results are important because they suggest that students can show improvement in their pronunciation even in the case where there is not explicit instruction.

In summary, previous research reveals that in experimental settings as well as in the classroom second language speakers are able to attain VOT values that are near to those that have been identified for native Spanish speakers in the production of voiceless stops. In the present investigation, we further investigate by answering the following questions: (1) What are the differences between aspirated and non-aspirated variants of /p t k/ in terms of voice onset time in the speech of this group of second language learners? (2) What is the impact of context of learning (study abroad vs. regular classroom) in reducing levels of aspiration in the speech of second language learners? (3) Is there an effect in the production of the voiceless stops associated with the phonetic context? (4) Are there differences in the entrance and exit recordings (pre and posttests)? (5) What is the importance of number of years of formal language instruction on the acquisition of voiceless stops in Spanish? (6) Are there differences in the pronunciation of voiceless stops related to self-reported use of Spanish outside the classroom? (7) Are there differences in the pronunciation of voiceless stops in female and male students?

3. Methodology

3.1 Participants

The students who were selected for this investigation are college students of Spanish as a second language in the USA. The participants are divided in two groups: twenty were taking Spanish classes in the regular program at the University of Colorado; while twenty-six were part of a ten week study abroad program in Alicante, Spain. The results of the oral proficiency interview (OPI) reveal that both groups of students averaged a proficiency level of intermediate-low. All students also completed the SAT II Spanish test before the beginning of the treatment period. In terms of this Spanish test, the regular classroom students average result was 512.5 (sd = 108.3), whereas the study abroad students average result was 441.9 (sd = 89.9). According to these scores, regular classroom students can be placed at the beginning of the third semester of university-level Spanish instruction in the USA, while the study abroad students can be placed slightly before the middle of the second semester of formal language instruction in the USA (Collentine submitted).

3.2. The language contact profile

All participants of this research project completed a language contact profile (Freed, Dewey, Segalowitz, and Halter 2001) at the beginning and at the end of the program. This instrument was very important to find out personal information about the speaker such as age, native language, and previous language-learning experiences, as well as information regarding traveling, languages spoken at home, years of formal language instruction in Spanish as well as other languages, time spent speaking Spanish with native speakers before and during the semester, time spent reading books, newspapers, and watching TV in Spanish.

3.3. Read aloud text

For the purpose of analyzing the speech of these two groups of second language learners, a short text containing words with /p t k/ in word-initial position was designed. The students read the text two times: at the beginning of the program and at the end of the program (entrance and exit recordings). This technique, widely used in mainstream experimental phonetics and phonology, makes it possible to compare the same targets at the beginning and the end of semester under the same conditions. Students did not receive any explicit phonetic instruction between pre- and post-tests. All recordings were digitized for performing an analysis of the data.

3.4. Procedure

Since we wanted to perform quantitative and acoustic analyses, we began by examining all target words containing /p t k/ word-initially by ear. From the 3,670 tokens found in the corpus, a sample of 100 cases was analyzed to determine the acoustic nature of aspirated vs. non-aspirated variants in terms of VOT. Following Lisker and Abramson (1991), wide-band spectrographs of the recordings were made and VOT was measured by timing the interval at the release of the stop and the beginning of voicing. The spectrographic analysis of the recordings was performed using the computer software Pqquirer.

3.5 Dependent and Independent variables

The dependent variable of this investigation is the production of /p t k/ in word-initial position. These targets can be pronounced with or without aspiration, so we have considered these two variants within the dependent variable. Following Lisker and Abramson (1991), average VOT values of non-aspirated for monolingual speakers are as follows: 1) 4ms for /p/, 2) 9ms for /t/, 3) 29ms for /k/. These scholars also reported the following average VOT values for English monolingual speakers: 1) 58ms for /p/, 2) 70ms for /t/, and 3) 80ms for /k/. Six different factors were included as independent variables: the nature of the following vowel (e.g. front back vowels; high, mid, and low vowels); time of recording (pre- and posttests); the context of learning (e.g. regular classroom, study abroad); number of years of formal language instruction (e.g. 0-3 years, 4-6 years, more than 6 years); self-reported use of Spanish outside the classroom (in terms of days/week [0-7] and hours/day [0-5]); and the sex of the informant.

4. Results and discussion

This section is divided in three parts. The first section describes the results of VOT measurements. In the second section, the 6 factor groups selected as significant by GoldVarb 2001 are presented. The third discusses the findings in order to answer the research questions presented in section 2.

4.1 Voice onset time results

VOT is a measure that determines the distinction between non-aspirated vs. aspirated variants of the voiceless stops. Lisker and Abramson (1991) have shown that normal VOT values of /p t k/ word-initial for native Spanish speakers range as follows: /p/ 0 to 15 ms, /t/ 0 to 15 ms, and /k/ 15 to 55 ms. These observations coincide with many of the studies presented in the literature review section (González-Bueno 1997a, Flege and Eefting 1987, etc), although native English speaking learners of Spanish tend to have higher values because of the influence of L1. We have taken the examples classified as aspirated and

non-aspirated and measure VOT in order to determine acoustically what each one of these terms means in the context of the present investigation. An understanding of aspiration in acoustical terms in the speech of second language learners is an important aspect that could have implications for providing an account of phonological acquisition as well as for offering new directions in language teaching. This observation is in agreement with González-Bueno's findings (1997), according to which native speakers of Spanish can perceive the production of aspirated variants of voiceless stops as a sign of foreign accent. Figure 1 shows the results of the VOT measurements obtained from the speech samples analyzed.

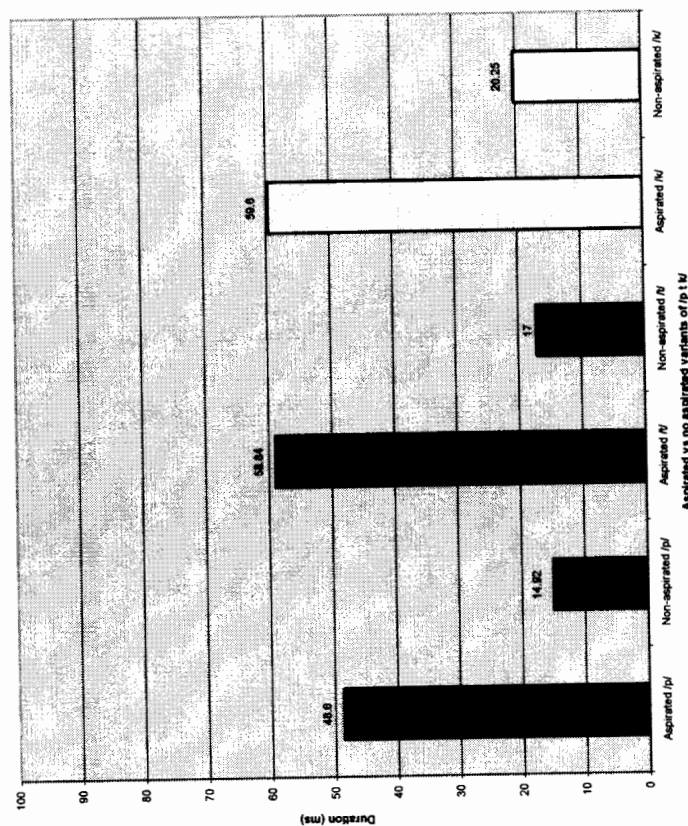


Figure 1: VOT of aspirated and non-aspirated variants of /p t k/

In the case of the voiceless bilabial stop /p/, aspirated variants were produced with an average VOT of 48.6 milliseconds (ms.), while non-aspirated variants were produced with a VOT of 14.92 ms. The measurements for voiceless coronal stop /t/ were as follows: aspirated variants have a VOT of 58.84 ms., while non-aspirated ones have a VOT of 17 ms. Finally, the average VOT for aspirated voiceless dorsal stops was 59.6 ms. while non-aspirated ones have a VOT of 20.25. These results reveal that there is an average difference in VOT of 38.29 ms. between aspirated and non-aspirated variants of /p t k/.

It is important to point out that even though there is consistency across different studies, the VOT measurements reported show some variation (see section 2). Nonetheless, a relevant difference in the production of voiceless stops is found when comparing VOT in English and Spanish, as it is the case in the present investigation. We can conclude that the impressionistic observations presented in textbooks for teaching Spanish pronunciation have a phonetic correlate in terms of a longer VOT in the production of aspirated variants of the voiceless stops.

4.2. Statistical results

This section is concerned with the analysis of the factor groups that could have an effect on the improvement of the pronunciation of voiceless stops in the speech of second language learners. For performing the statistical analysis GoldVarb 2001 was used. This statistical software allows for clarification of how a group of internal and external constraints are related to the dependent variable. GoldVarb performs a logistic regression analysis, which reveals the factor groups (independent variables) affecting the dependent variable. The program also indicates the positive or negative effect of each one of the factors included within each factor group (see Berdan 1996 and Young and Bayley 1996 for a more detailed description of GoldVarb). As stated before, the dependent variable of the present study is production of the voiceless stops. Non-aspirated variants of /p t k/ were taken as the application value since we want to determine what factors have a positive impact on attaining a more native-like pronunciation. GoldVarb reveals the probabilistic weight of each one of the constraints not only in relation to a given variant but also in terms of the overall effect of significant factors regarding that variant. A weight greater than .500 favors the application value and a lesser probability disfavors it.

The factors found to be statistically significant are presented in Table 1 in order of selection. This order of selection is crucially important because it indicates the degree of impact of the factor group selected on the dependant variable from most important to least important. According to this explanation, factor group TIME OF RECORDING, which takes into consideration whether the recording session was done at the beginning or ending of the semester, has the greatest impact on alternant tokens. Factor group FOLLOWING VOWEL is the next in the hierarchy. The next important constraint is CONTEXT OF LEARNING (regular classroom vs. study abroad). The original analysis also included a factor group considering the nature of the following vowel in terms of backness as well as a factor group measuring the self-reported use of Spanish outside the classroom during the semester in terms of number of days per week. GoldVarb ruled out both factors as not statistically significant.

The data in Table 1 are organized as follows: the left-hand column shows only the significant factor group in order of selection. The next column indicates the factor values for each factor group selected. The column identified as "No. of cases" has two numbers separated by a slash: the first one refers to

the cases of non-aspirated variants of /p t k/; the second one indicates the total of tokens found within that same factor or variant. The next column gives the percentage of voiceless stops produced without aspiration. The weight column specifies the probabilistic weight for each factor within each group. The range of the weight varies from 0 to 1.

Table 1: Factor groups selected in the acquisition of voiceless stop analysis

Factor group	Factors	No. of cases	%	Weight
Time of recording	Exit	361/1723	21	.593
	Entrance	261/1947	13	.425
Following vowel	Low	115/550	20	.593
	High	182/1008	18	.512
	Mid	240/1558	15	.459
Context of learning	Regular Class	282/1590	17	.694
	Study abroad	342/2080	16	.349
Years of formal language instruction	0-3 years	200/1110	18	.580
	4-6 years	296/2000	14	.426
	7 or more	128/560	22	.604
Self-reported use of Spanish before the semester	Regularly	257/1360	18	.550
	Not regularly	367/2310	15	.470
Self-reported use of Spanish during the semester	0-1 hours	201/1510	13	.254
	2-5 hours	423/2160	19	.680
Sex	Female	567/2870	19	.581
	Male	57/743	7	.235

(input probability = 0.142 (624/3670))

The statistical analysis reveals that the most important factor is TIME OF RECORDING. Students show improvement in their pronunciation of the voiceless stops at the end of the semester in comparison to the pronunciation observed in the entrance recordings. This result indicates that exposure to the language has an effect in attaining a more native-like pronunciation of voiceless stops in Spanish.

The factor group FOLLOWING VOWEL was also selected as an important factor in the analysis of voiceless stops in the speech of second language learners. The finding reveals that low and high vowels have weight in the borderline for favoring the production of non-aspirated stops, while mid vowels have a weight that clearly disfavors non-aspirated variants. Further analysis is needed to understand whether there is a phonological pattern behind these results or whether there are phonetic arguments explaining the conditioning found.

CONTEXT OF LEARNING is the next most important group factor according to the statistical results. Contrary to what was expected, regular class students

have a weight of .694, which indicates that this group of students is more likely to produce non-aspirated variants of the voiceless stops. In contrast, study abroad students have a weight of .349, which reflects a tendency to disfavor the production of non-aspirated voiceless stops. This surprising result will be explained in more depth in the discussion section, where the possible reasons accounting for this outcome are explored.

The next group factor in the hierarchy is YEARS OF FORMAL LANGUAGE INSTRUCTION. As can be seen in Table 1, the most important outcome in this case is that the group of students who have 7 or more years of Spanish instruction is more likely to produce non-aspirated voiceless stops. In the groups of speakers with less formal instruction, a clear pattern is not found. While students having from 0 to 3 years of formal instruction are on the borderline for favoring non-aspirated variants, individuals having from 4 to 6 years of formal instruction disfavor them. This factor is further examined in the discussion section in which we observe its interaction with other factors such as CONTEXT OF LEARNING.

The statistical analysis also shows that SELF-REPORTED USE OF SPANISH BEFORE THE SEMESTER is also an important factor for explaining improvement in the pronunciation of voiceless stops. The group of students reporting use of Spanish with certain regularity outside the classroom before the semester has a borderline weight of .550, which is an indication of a trend toward favoring non-aspirated variants of /p t k/. In contrast, students reporting not using Spanish regularly are less likely to produce non-aspirated variants. These results reveal the importance of having opportunities to be exposed to the target language. In the following section, we further analyze these results and examine their interaction with the factor group CONTEXT OF LEARNING.

The findings regarding the factor group SELF-REPORTED USE OF SPANISH DURING THE SEMESTER reveal that students reporting use of Spanish outside the classroom from two hours up to five hours favor the pronunciation of non-aspirated variants of /p t k/. On the contrary, students reporting use of Spanish up to one hour do not show an improvement in their pronunciation. This result is consistent with what we have seen above regarding YEARS OF FORMAL LANGUAGE INSTRUCTION and SELF-REPORTED USE OF SPANISH BEFORE THE SEMESTER in the sense that time of exposure to the target language has a positive effect on attaining a more native-like pronunciation at the segmental level.

The last factor group selected by GoldVarb in the analysis of the acquisition voiceless stops is SEX. As can be seen in Table 1, the weight for female students indicates a borderline tendency toward favoring non-aspirated variants of /p t k/, while male students clearly disfavor the production of them. Perhaps these results can be interpreted as a reflection of conservatism in the speech of women (Labov 1972, Silva-Corvalán 1989, 2001) in the sense that women could be trying to achieve a more native-like pronunciation, while men could be more concerned with getting their meaning across. In fact, this observation regarding male students is consistent with the results of Brecht et

al. (1995) regarding linguistic gain in a study abroad program by male students of Russian. They found that male students were able to obtain better scores in the Educational Testing Service Listening test as well as in the Oral Proficiency Interview (OPI) test. With respect to the latter, however it should be pointed out that, the OPI measures ability to communicate, but does not measure accuracy in the production of the sounds of the target language, so the fact that students show better speaking skills does not necessarily show that they have increased accuracy in pronunciation.

4.3. Discussion

The findings presented above indicate that regular class students show a better performance than study abroad students in the pronunciation of voiceless stops. How can we explain this outcome? Given the fact that factor groups YEARS OF FORMAL LANGUAGE INSTRUCTION and SELF-REPORTED USE OF SPANISH DURING THE SEMESTER show strong results for predicting less aspiration in the speech of second language learners, we decided to explore whether the regular classroom students who show better performance are also the ones who have more years of formal language instruction and who report using the target language more outside the classroom. If the interaction among these factors were significant, we would have arguments to explain why regular classroom students show more improvement in their pronunciation in comparison to study abroad students. If our findings indicated that the interaction is positive, we would be able to suggest that time of exposure would be more relevant than context of learning. It is also important to point out that such results do not deny the positive learning experience that a student can get by studying abroad. However, it could be an indication that a short program of 10 weeks is not enough to find improvement in pronunciation at the segmental level. Table 2 shows the results of the probabilistic analysis. Figure 2 shows the probabilistic weights for the interaction between CONTEXT OF LEARNING and YEARS OF FORMAL LANGUAGE INSTRUCTION.

Table 2: Factor groups selected while analyzing the interaction of CONTEXT OF LEARNING with YEARS OF FORMAL LANGUAGE INSTRUCTION and SELF-REPORTED USE OF SPANISH OUTSIDE THE CLASSROOM

Factor group	Factors	No of cases	%	Weight
Interaction between CONTEXT OF LEARNING and YEARS OF FORMAL LANGUAGE INSTRUCTION.	Regular class 7 years or more	75/320	23	.688
	Study abroad 0 to 6 years.	289/1840	15	.459
	Other	260/1510	17	.508
Interaction between CONTEXT OF LEARNING and SELF-REPORTED USE OF SPANISH OUTSIDE THE CLASSROOM.	Regular class 5 or more hours	95/240	39	.805
	Study abroad 0 to 4 hours	14/160	8	.247
	Other	515/3270	15	.488

(input probability = 0.151 (624/3670))

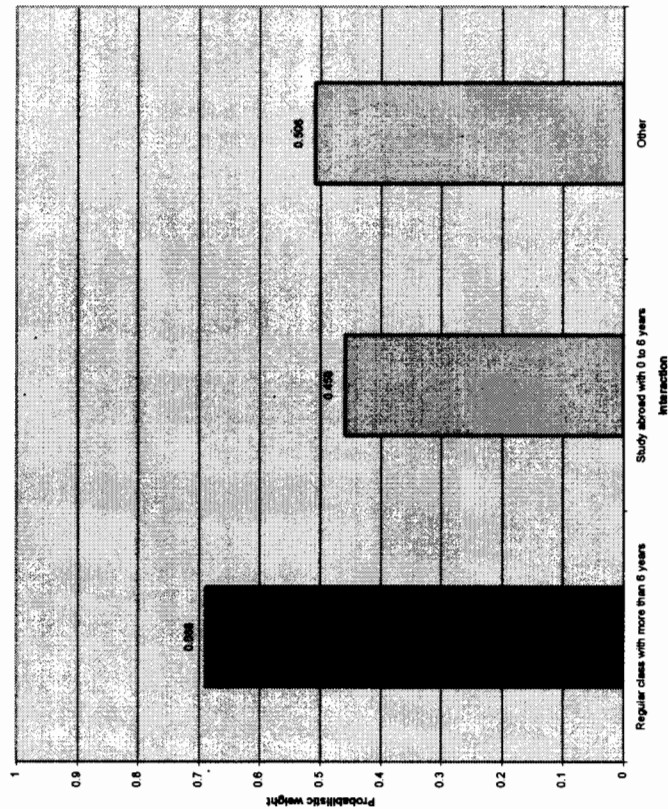


Figure 2: Interaction between CONTEXT OF LEARNING and YEARS OF FORMAL LANGUAGE INSTRUCTION

The statistical results reveal that the interaction between CONTEXT OF LEARNING and YEARS OF FORMAL LANGUAGE INSTRUCTION turns out to be significant. Regular classroom students who have had 7 or more years of language instruction are less likely to aspire voiceless stops when speaking Spanish, whereas study abroad students with up to 6 years of formal instruction disfavor non-aspirated variants of /p t k/. This is an important finding because it explains why regular class students show a better performance in comparison to study abroad students in the general results presented above (see section 4.2). As pointed out at the beginning of the discussion section, regular classroom students having 7 or more years of language instruction show a better pronunciation because of the long period of language exposure, which is reflected at the segmental level in their speech production. Figure 3 presents the probabilistic weights for the interaction between CONTEXT OF LEARNING and SELF-REPORTED USE OF SPANISH OUTSIDE THE CLASSROOM.

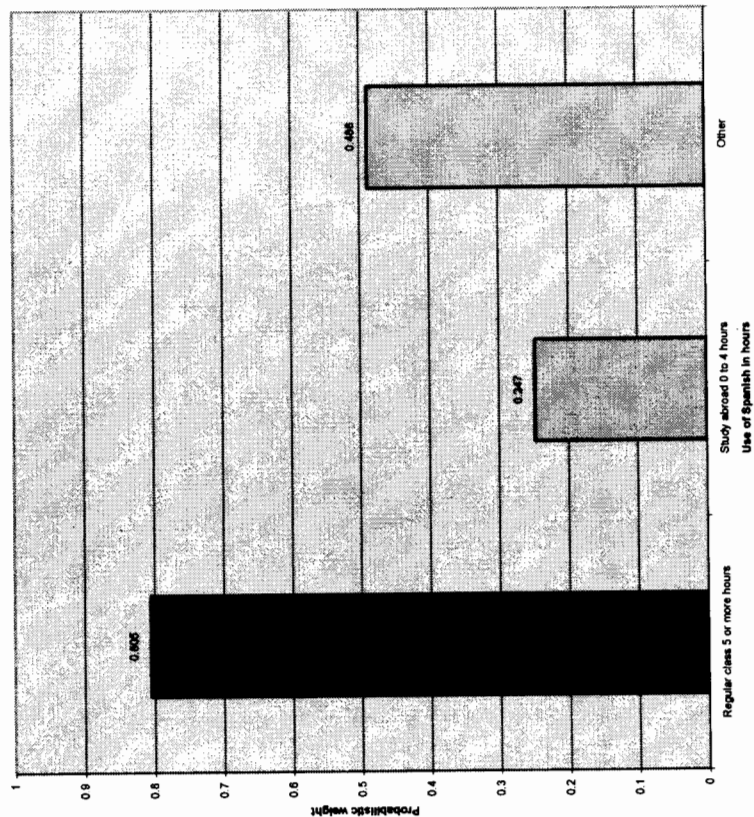


Figure 3: Interaction between CONTEXT OF LEARNING and SELF-REPORTED USE OF SPANISH OUTSIDE THE CLASSROOM

The results for the interaction between CONTEXT OF LEARNING and SELF-REPORTED USE OF SPANISH OUTSIDE THE CLASSROOM are also significant according to the statistical analysis. Regular classroom students reporting 5 or more hours of use of Spanish outside the classroom are more likely to produce non-aspirated variants of /p t k/. The weight obtained for this group of students is .805, which is an indication of a strong tendency. On the contrary, study abroad students reporting less than 5 hours use of Spanish outside the classroom tend to disfavor the production of non-aspirated variants of /p t k/. Once again, time of exposure seems to be the key factor for understanding why regular classroom students outperformed study abroad students. This tendency of improvement in the pronunciation of /p t k/ with or without specific phonetic instruction is also found by Lord (2002), reinforcing the claim that exposure to the target language can have an impact on pronunciation at the segmental level. In summary, the results of the interaction provide us with a good answer for explaining why regular class students show a better pronunciation than study abroad students. We have found that regular class students who have 7 or more years of formal language instruction and who have reported using Spanish outside the classroom 5 or more hours are the ones who outperform study abroad students.

5. Conclusions

The present investigation has provided an acoustic characterization of Spanish voiceless stops in the speech of second language speakers. The findings of the acoustic analysis have revealed that there is an average difference in VOT of 38.29 ms. between aspirated and non-aspirated variants of /p t k/. These results offer a more exact phonetic description of aspiration of voiceless stops in second language phonology, which complements our understanding of impressionistic observations commonly presented in textbooks for teaching Spanish pronunciation. The VOT values obtained are a little bit higher than the average reported for native monolingual speakers of Spanish. This pattern is consistent with previous studies (Flege 1987, 1988; Flege and Eefting 1987, 1988; González-Bueno 1997a, 1997b, and Lord 2002.) where some improvement is reported, but such improvement in shortening VOT values never reach the same level that has been observed for native monolingual speakers of Spanish.

Regarding CONTEXT OF LEARNING, the findings indicate that regular class students perform better than study abroad students. This result reflects the fact that it is the group of regular class students with 7 or more years of formal language instruction and who report frequent use of Spanish outside the class that shows less aspiration of initial voiceless stops. This finding suggests that more exposure to the target language has a positive impact on second language phonology at the segmental level. This observation is reinforced if we take into account that factor groups YEARS OF FORMAL LANGUAGE INSTRUCTION, SELF-REPORTED USE OF SPANISH BEFORE THE SEMESTER, and SELF-REPORTED USE OF

SPANISH DURING THE SEMESTER were selected as important predictors of non-aspirated variants of /p t k/. We want to point out that Díaz-Campos submitted has found out that when changes across time in study abroad and regular classroom students are taken into account both groups show improvement in their pronunciation. Díaz-Campos' results not only reveal the importance of study abroad programs of language instruction, but also the crucial role played by formal language instruction.

The analysis presented here also reveals that SEX is an important factor in the analysis of second language pronunciation. Female students show a borderline result toward favoring non-aspirated variants of /p t k/. Further research should explore whether this finding reflects a pattern of linguistic behavior in female speakers.

Notes

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- 1 Flege and Eefting 1988 include stimuli in which VOT was incremented in 10ms steps from -60 to 90ms. Subjects were asked to imitate the stimuli presented.
- 2 González-Bueno also found significant statistical results in the case of /g/. Nonetheless, we are focusing our discussion of results on /p t k/ since these are the target segments of the present investigation.
- 3 According to Lord (2002) the experimental group produced the following VOT values in the pre-test: /p/ 28.63, /t/ 29.77, and /k/ 42.68. The VOT values reported for the post-test are as follows: /p/ 24.14, /t/ 24.94, and /k/ 37.07.

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Appendix

Table 3: Mean VOT in Spanish word-initial stops produced (adapted from Flege and Eefting (1987:74).

Group	/p/	/t/	/k/
Spanish children	VOT	16	17
	Standard Deviation	5	4
	No. of tokens	50	50
Spanish adults	VOT	18	22
	Standard Deviation	5	6
	No. of tokens	50	50
Bilingual children	VOT	7	10
	Standard Deviation	4	5
	No. of tokens	50	50
Earlier childhood bilinguals	VOT	17	19
	Standard Deviation	7	5
	No. of tokens	50	50
Later childhood bilinguals	VOT	11	15
	Standard Deviation	4	4
	No. of tokens	50	50

Table 4: Mean VOT in English word-initial stops produced (adapted from Flege and Eefting (1987:76).

Group	/p/	/t/	/k/
English children	VOT	70	82
	Standard Deviation	15	16
	No. of tokens	50	50
English adults	VOT	78	89
	Standard Deviation	16	15
	No. of tokens	50	50
Bilingual children	VOT	40	54
	Standard Deviation	10	10
	No. of tokens	50	50
Earlier childhood bilinguals	VOT	57	74
	Standard Deviation	14	16
	No. of tokens	50	50
Later childhood bilinguals	VOT	48	56
	Standard Deviation	20	16
	No. of tokens	50	50

Negotiating Obstacles: Extended Repair Sequences in Native/Nonnative Interaction

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Introduction

In this paper, we analyze an extended repair sequence in interaction between a native speaker (NS) and a nonnative speaker (NNS) of Spanish. Our goal in presenting these data is to elucidate the highly co-constructive nature of repair and to show how repair may be constrained by the social considerations of the participants' efforts to present themselves as 'competent.'

Literature Review

As defined by Schegloff et al. (1977), repair is the means by which interactants resolve problems of speaking, hearing, and understanding. Repair is an important mechanism by which interactants are able to construct and maintain intersubjectivity, that is, to jointly construct meaning. Repair may be initiated by either the speaker or the hearer, and it may be completed by either of the participants. Conversation analysis additionally notes that repair is influenced by social constraints on repair initiation. Schegloff et al. found that, in general, there is a preference for self-initiated, self-completed repair, and this is often performed within the same turn as the repairable. Preference is not a statistical term, but rather refers to the markedness of certain actions. A preferred action, such as self-initiated, self-completed repair, can transpire without any hesitation or linguistic marking, whereas a less preferred action is likely to be marked with some type of dispreference marker, such as hesitation or hedging. This may also be conceived of in terms of face. Non-face-threatening acts are produced without hesitation, while potentially face-threatening acts are marked to demonstrate the speakers' understanding of the potential implications of their actions. In cases where the recipient initiates the repair, it generally occurs in the turn coming immediately after the trouble source turn, as ordinarily problems are dealt with as soon as possible.

Schegloff et al.'s analysis of repair and the finding of a preference for self-initiated, self-completed repair over other-initiated, other-completed repair was based on data from conversations between NSs of English. Other-correction was found to be highly constrained, with one apparent exception. A limited amount of their data included adult/child interaction, and in these data they observed that other-correction did not appear to be as infrequent. They theorized that perhaps this differing preference organization might be applicable