Spanish in Contact in the Peruvian Amazon: An Examination of Intervocalic Voiced Stops

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1. Introduction

1.1. Overview

Spanish is in contact with many languages, in diverse regions, a situation that has been studied in depth from numerous perspectives (see Díaz-Campos 2011). Nonetheless, relatively little attention has been devoted to the Amazon, where Spanish is in contact with dozens of less well-known languages (Dixon & Aikhenvald 1999, Aikhenvald 2012). In a recent treatment of Peruvian Amazonian Spanish, Jara Yupanqui (2012) notes that a number of historical and ideological factors have contributed to the development of Spanish within this region, including the prehispanic existence of an indigenous lingua franca, the role of Jesuit missions and subsequent land owners in the spread of Spanish, as well the surge in migration from other highland, coastal, and Portuguese-speaking regions due to the rubber trade and later oil extraction. The current study adds to our knowledge of the Spanish spoken in this region, specifically a variety which has emerged due in part to contact between Spanish and Bora, an Amazonian language spoken along the Amazon basin of Colombia and Peru (Thiesen 1996). Similar to a number of indigenous communities in this region (Cerrón-Palomino 1989, Freeland 1996, Thiesen & Weber 2012), ethnically dominant Bora communities are shifting to Spanish. Bora has a phonological inventory that is different from Spanish (Thiesen & Weber 2012), including the lack of voiced stops, which raises questions regarding the phonological inventory of bilingual speakers of these two languages. In the current investigation we begin to address these issues with an experimental analysis of Spanish voiced stops produced by bilinguals from three Bora-Spanish communities of the North-Western Amazonian region of Peru. The data of the present study are drawn from sociolinguistic interviews and community-wide surveys from these communities. Subsequently, we compare these data to that of monolingual Spanish speakers residing in Iquitos, the capital city of the Loreto department of Peru. In Iquitos, Spanish is the lingua franca although the city is surrounded by a number of other bilingual indigenous communities, such that the Spanish monolinguals living there may also be in contact to varying degrees with other contact varieties of Spanish.

The main focus of our linguistic analysis is the realization of voiced intervocalic stops. We adopt a laboratory approach in order to measure the degree of lenition or consonant weakening word-internally (Colantoni & Marinescu 2010, Hualde, Simonet & Nadeu 2011). Results indicate that the phonological inventories of the bilingual Bora-Spanish speakers demonstrate non-standard production of intervocalic stops, while the Iquitos speakers' production of intervocalic stops approaches that of monolingual varieties from other Spanish-speaking regions. The remainder of the paper is organized as follows: in the subsequent sections of this introduction we describe the sociolinguistic background and phonological inventories of the languages in contact, as well as provide a brief synopsis of two

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previous studies on intervocalic stops in Spanish; in section (2) we discuss the methodology, including the communities where data collection took place, participants, recording procedures, and database; in section (3) we report the results, while in section (4) we discuss these findings before offering some general concluding comments in section (5).

1.2. Sociolinguistic background

Peru is a country of vast linguistic diversity. In fact, it holds the highest absolute number of indigenous language speakers in all of Latin America (Hornberger & López 1998). While Quechua and Aymara are among the most widely spoken indigenous languages in Peru, still some 300,000 to 400,000 inhabitants, comprised of 63 ethno-linguistic groups, speak one or more of the dozens of languages found in the country's Amazon basin (Aikman 1995, Pozzi-Escot 1988)[1]. In spite of these numbers, many of Peru's indigenous languages are steadily losing status and power to the dominant Spanish language (Adelaar 2010).

The Bora language is part of the Witotoan family, a language family which is commonly considered to comprise the languages Bora (including the close dialectal variant Miraña), Muinane, Ocaina, Nonuya, and Witoto proper (Seifart 2007). Estimates of Bora speakers fall between 2000 and 3000 when communities of speakers along both the Colombian and Peruvian Amazon basin are included (Thiesen & Weber 2012). Approximately 1000 of these Bora speakers live within Peru's boundaries. Bora is an agglutinative language with flexible word order including SOV and OSV orders, although the subject appears most frequently as a suffix of the verb, or OV-s (Weber & Thiesen 2001).

Population movements have characterized the histories of Witotoan language speakers. In the early twentieth century, the majority of these speakers lived in what is now Southern Colombia between the Caquetá and the Putumayo rivers (Seifart 2007). Echeverri (1997) refers to the Witotoan language groups as belonging to a tightly integrated cultural complex called the "People of the Center", characterized by regular intermarriage and shared ceremonial and mythological systems. Around 1930, and in direct relation to the rubber boom, large numbers of Witotoan language speakers were uprooted and transported to Peruvian territory. Currently, Bora speakers live along the Ampiyacu and Yaguasyacu rivers of Peru, and are in a process of transculturalization toward Spanish-dominated national culture, placing their language in danger of becoming extinct (Thiesen & Weber 2012). Today, most Bora speakers under the age of 50 are fluent in Spanish, with only a handful of true monolingual Bora speakers remaining in Peru (Thiesen & Weber 2012).

1.3. The ecology of Bora-Spanish bilingualism

Speakers and speech communities operating with multiple linguistic systems are epicenters for linguistic innovation and language change (Mufwene 2001, Weinreich 1953, Winford 2003). In situations of prolonged and intense contact, both languages may be affected through transfer, interference, code-switching and input ambiguity, leading to lexical borrowing, convergence, attrition and shift (Thomason & Kaufman 1991, Yip & Matthews 2007). Bilingualism, which necessarily includes language contact and language acquisition, transpires at the individual and societal level (Grosjean 2008, Romaine 1995). Geo-political factors result in different outcomes for language change and transmission (Bayley, Cameron & Lucas 2013). For example, Guarani and Spanish in Paraguay (see Gynan 2011) can be classified as a case of societal and stable bilingualism given that both languages have been used in a variety of political/social spheres for an extended period of time. This situation has affected the structure of both languages. In situations of unstable bilingualism, such as that of many immigrant communities in the United States (see Romaine 2010), generational decline

[1] We acknowledge that the number of indigenous languages and minority-language speakers in Peru is a point of continuous debate (and change); for our purposes we note that there exist numerous bilingual zones in Peru where Spanish intersects with indigenous languages.

occurs as speakers lose language proficiency, stop transmitting their original language, and adopt or shift to the dominant societal language. Language shift may result in the formation of new language varieties. For example, the long-term bilingual situation between speakers of Spanish and varieties of Quechua in the Andean regions of Bolivia, Ecuador and Peru has resulted in a distinct variety of Spanish known as Andean Spanish, which is distinguishable from other varieties by a number of innovative (or non-standard) phonological, lexical, and syntactic properties (Escobar 2011). Often in bilingual communities, one language will have more dominance or prestige and be considered the majority language while the other is considered a minority language. Speaker attitudes and the linguistic planning implemented by a country, amongst other factors, dictate the maintenance of the minority languages.

In the current study we analyze the Spanish that has emerged in three bilingual communities that are ethnically Bora, isolated in the Peruvian Amazon. The youngest generation is dominant in Spanish and has limited knowledge of Bora. Their linguistic input comes in the form of a variety of Spanish which can be considered "non-standard" given its prolonged contact with Bora and its lack of features which are typical of the Spanish used in the media, as well as more prominent social, political and educational centers of the country. The elders in the community learned Bora as a first language and only gained consistent access to Spanish input after childhood, and thus are second-language speakers of Spanish. The remaining speakers can be categorized somewhere in the middle of these two extremes of the Bora-Spanish bilingual continuum, having been exposed to both languages to varying degrees throughout their lifetimes. Many of these speakers can be considered balanced bilinguals although the contexts of use of each language vary based on interlocutor. Speakers in the Bora communities receive schooling primarily in Spanish, with some additional instruction in Bora; however, their community of practice, social networks, and opportunities for communication with speakers of non-contact varieties of Spanish is almost negligible.

Clements (2009: 18) describes three key factors that should be considered in situations of language borrowing and shift: contact intensity, markedness of the feature to be learned or borrowed, and typological fit between the languages in contact. Regarding the contact between Bora and Spanish in the Peruvian Amazon, the level of contact intensity is high as both languages exist in the same geographic space and are continually used by the same speakers, the phonological process of spirantization is marked for the Bora speakers learning/shifting to Spanish as this is not necessarily an active process for stops in their native language system[2], and there is little typological fit between the languages in question. While we make an effort to control for these factors in the current study, our primary aim is to analyze one phonological process in the speech community as a whole: spirantization or lenition of voiced stops in Spanish, or lack thereof, in intervocalic position. As discussed in Simonet (2014), we acknowledge that in bilingual communities of this nature there is almost certainly first-to-second as well as second-to-first interlingual phonetic interference. However, in the current study we only examine the potential effects of Bora on the production of Spanish in this bilingual community.

1.4. Phonological inventories

Spanish has three voiceless plosive phonemes /p t k/ and three voiced plosive phonemes /b d ɡ/. In intervocalic contexts (both word-internally and across word boundaries), voiced stops undergo spirantization and are realized as approximants [β ð ɣ] rather than fricatives (Hualde 2005). Hualde, Simonet, and Nadeu (2011: 304) confirm that this process is completely systematic in Spanish, stating that it is "found in all speech styles, including careful reading style. Stop realizations of /b d ɡ/ in intervocalic position would be emphatic or anomalous in Spanish."

In contrast, Bora has a phonemic inventory which is distinct from standard Spanish (see Thiesen 1996 and Thiesen & Weber 2012). Aside from being a tonal language, it consists of a number of vowels and consonants not found in Spanish, including lax high and mid vowels, a coronal affricate, and aspirated counterparts of several plain consonants. Stops display a fortis-lenis distinction

[2] A separate acoustic analysis is needed in order to provide laboratory evidence for this assertion regarding lenition of stops in Bora.

according to aspiration, while orthographically /p^h t^h k^h/ and /p t k/ are represented as <p, t, k/c> and <b, d, g> respectively. Further, Bora has a voiced bilabial fricative phoneme /β/ represented as <v> orthographically, which is realized as [β] regardless of context.

Thus, for Bora-Spanish bilinguals to acquire production of Spanish stops that is similar to monolingual standard varieties[3], the bilinguals are confronted with one or more tasks depending on what type of acquisition is taking place (see Genessee 2006 for a general discussion of bilingual phonological acquisition, and Bosch & Sebastián-Gallés 2003 and Fabiano-Smith & Barlow 2010 for studies of early bilingual acquisition). If the speakers are simultaneous bilinguals, then either separate (or in some cases overlapping) systems must be developed in tandem, or a simplified, converged, or undifferentiated system may be used. If the speakers are early sequential bilinguals, then they must incorporate a Spanish voicing contrast into their original system of contrasts, a system which may or may not be stable given its recency of development. Although the focus of this study is on how Spanish stops are developed within this context of contact with Bora, the reverse effect on Bora stops is another area to be explored. While an analysis of the specific nature of language acquisition for these Bora-Spanish bilinguals is beyond the scope of the present paper, in either case we do know that schooling takes place primarily in Spanish for the younger generations at which point speakers have the opportunity to acquire a more Spanish-like production of stops.

In this study, several Bora-Spanish bilinguals demonstrate the use of voiced stops in the expected contexts but still show the use of aspirated voiceless stops often in stressed position in Spanish (instead of simple voiceless stops), which suggests an intermediate system that contains /p^h t^h k^h/ in contrast with /b d g/ (see Figure 1). In addition, the voiced stops produced by these bilinguals do not seem to undergo lenition to the degree observed for monolingual varieties of Spanish. That is, these voiced allophones are more stop and fricative-like between vowels than the standard approximant for monolingual varieties of Spanish. To quantify this claim, we have examined the degree of closure (or constriction) of intervocalic stops in the speech of Bora-Spanish bilinguals by measuring the drop in intensity during the production of the stop consonant in comparison to the following vowel.

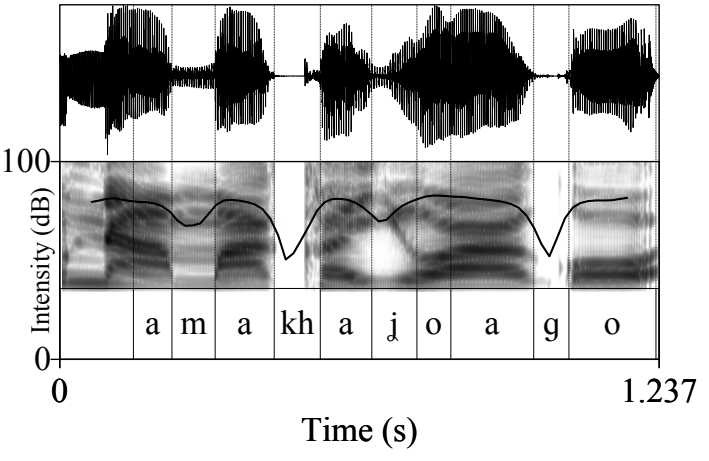

Figure 1: [aˈmak^{h}a ˈjo ˈago] from *en una hamaca yo hago en siete días* 'I make a hammock in seven days' with aspirated voiceless velar [k^h] and partially voiced [g]. Dark line represents intensity contour.

[3] We are grateful to one of the reviewers for pointing out that there are issues with comparing these speakers to other Spanish speakers in terms of which terminology should be employed. That is, these bilinguals may be fully fluent in their local or contact variety of Spanish or even be considered native speakers depending on their age of acquisition. In that sense, without more specific information regarding order of acquisition, it may be more appropriate to make comparisons between these bilinguals and other monolingual Spanish speakers, instead of distinguishing between groups as either non-native or native.

1.5. Previous literature

There are two recent studies[4] which serve as a point of departure for the present study: Colantoni and Marinescu (2010) and Hualde, Simonet, and Nadeu (2011). In the first study, Colantoni and Marinescu (2010) addressed the weakening of both voiceless and voiced Spanish stops in intervocalic position. In their study, they analyzed the relative CV intensity-ratio, duration, and percentage of voicing for intervocalic stops. The data were derived from target words taken from dialectological interviews. For each participant, a minimum of 20 tokens per stop was extracted (20 words x 6 consonants = 120). All six speakers were native Argentinean males from either the Corrientes or San Juan provinces. Results indicated that voiceless stops were not weakening in the two Argentinean dialects observed. However, they found that voiced stops were almost categorically realized as approximants. Thus, in these varieties of Argentine Spanish, they found no correlation between the lenition of voiced and voiceless stops (2010: 111).

Hualde, Simonet, and Nadeu (2011) also examined lenition of stops in intervocalic position. Their data, taken from both spontaneous and scripted speech, were compiled from 20 bilingual Spanish/Catalan speakers of Spanish, from Majorca, Spain (although their speakers were strongly dominant in Spanish). Their results indicated that lenition of /p t k/ as voiced allophones showed an intermediate degree of constriction, being significantly different from both voiced /b d ɡ/ with the least amount of constriction and voiceless /p t k/ with the greatest amount of constriction. Hualde, Simonet, and Nadeu argue that experimental measurements of synchronic data, such as that of the voicing of intervocalic stops, can reveal invaluable insights into more general phonological processes, such as phonological recategorization and reductive sound change. They conclude that reductive sound changes begin as across-the-board conventionalized phonetic processes, affecting all targets in the appropriate phonetic context equally.

As can be seen from the brief review presented here, recent experimental approaches to intervocalic stop realization have produced valuable perspectives on more general phonological processes such as allophonic variation and sound change (see also Carrasco 2008, Cole, Hualde & Iskarous 1999, Eddington 2011, Ortega-Llebaria 2004, Parrell 2011). In the current paper, we build on this research and follow an experimental approach to the examination of intervocalic stops in a less-commonly studied situation: Spanish in the Peruvian Amazon. Our aim is to use experimental measures of stops in the intervocalic position as a means of investigating language variation and change in the Peruvian Amazon in communities undergoing shift toward Spanish, thereby providing insights into the nature of bilingual phonological inventories and the results of language contact.

2. Methodology

2.1. Recordings and participants

The data from the current study are comprised of sociolinguistic interviews and community-wide surveys conducted in conjunction with members of *Project Amazonas*, a joint USA-Peruvian humanitarian, conservation, education, and non-profit organization which has operated in the upper Amazon River region for 16 consecutive years[5]. Each interview was obtained by one of the principal investigators (the second co-author), in collaboration with Manuel Ramírez López, a fluent Yagua-Spanish bilingual and native of the Loreto Amazon region, who is President of the Yagua Federation, an indigenous rights group aimed at promoting cultural awareness within the Peruvian Amazon,

[4] There are a number of relevant studies that analyze intervocalic stop production and lenition in Romance languages (e.g., Hualde, Nadeu & Simonet 2010, Hualde & Nadeu 2011, among others). However, due to space limitations, we review two studies on Spanish which exemplify the methodology chosen in the current study.

[5] Data were collected during 2011 with *Project Amazonas* (http://www.projectamazonas.org/). The description of the community is based on data from that timeframe.

particularly among the Yaguas[6]. Our method consisted of going house-to-house and inviting community members to participate in a study on language and cultural diversity within Peru.

All interviews were conducted in Spanish and lasted 15-45 minutes. The semi-directed interviews centered around community norms, culture, existing problems, changes in the past 10-20 years, educational opportunities, languages spoken in the home and community, as well as attitudes toward other ethnic communities, languages, and larger city life in general. Once the interview portion was finished, participants next watched the Pear Story video (http://www.pearstories.org; Chafe 1980), a movie that contains sound but no dialogue in which a man harvesting pears engages with several passers-by. Participants watched the video and were asked to simultaneously narrate the story as if relating it to a friend who could not see the video. For most participants the resulting narration was a present-time narrative. The interviews and narratives were recorded with a Tascam digital recorder and head-mounted Dynex noise-cancelling microphone. Once the participants finished the narration in Spanish, those participants who had indicated fluency in Bora were asked to again produce the simultaneous narrative but this time in Bora. Finally, all participants (orally) answered a survey that prompted socio-demographic information about themselves, their households, and their communities, including oral and written fluency in Spanish and Bora.

In the current study, we report data from communities which ethnically identify themselves as Bora. These three communities are: Aconcolonia, Brillo Nuevo, and Nuevo Perú. The first, Aconcolonia, is a predominantly Bora community heading a network of other Bora communities along the Yaguasyaku River. There are currently 62 community members divided among 12 families (8 households). Current Bora-community laws forbid endogamy and thus locals are increasingly marrying and reproducing with outsiders and non-Bora speakers. In the community, schooling goes to completion of primary education (grades 1-6). There is a bilingual teacher who was trained in the province capital Iquitos and teaches in both Bora and Spanish. However, most of the material and lessons are taught in Spanish. Thus, Bora is taught as a second language in the school, and unless students are taught Bora at home, they will be predominantly Spanish speakers.

The second community, Brillo Nuevo, is the largest of the Bora network of communities along the Río Yaguasyaku with a total population of 305 members. The ethnic makeup of the community is almost completely Bora but different Bora tribes and indigenous groups are slowly integrating. A number of members are from Aconcolonia, sharing the same last name, reportedly moving there because it is the only community with a secondary school and a (semi)functioning medical post, and because it is closer to Pebas where members travel at least biweekly in order to purchase necessary goods (soap, rice, etc.) and to sell their artwork.

The third local Bora community surveyed is again along the Río Yaguasyaku and flows into the Ampiyacu, closer to the district of Pebas. Nuevo Perú currently totals 73 community members divided amongst 17 families living in 14 households. The community has no telephone, electricity or local health post, making travel to Pebas (where communication is in Spanish) essential for medical attention. Children receive education through primary school and then must travel or move to Brillo Nuevo for further education (secondary school). In rare cases where money permits, a student continues his geographic move and resides in Pebas for technical school/post-secondary education. For a true four-year university education, one must move to Iquitos, a situation which is extremely rare.

Our last participant group consists of monolingual Spanish speakers from Iquitos. Iquitos is the capital city and hub of the Peruvian Amazon region, Loreto. Little attention has been paid to the variety of Spanish spoken in Loreto, particularly if one compares this to the attention that has been given to the variety of Spanish spoken in the Andes (see Coronel-Molina & Rodríguez-Mondoñedo 2012, and references therein). The extent to which contact with Amazonian Languages of the region has shaped this variety of Spanish is a matter of empirical investigation which has yet to be conducted in great detail (see Escobar 1978 and Jara Yupanqui 2012). In addition to our primary focus on bilingual stop production in Bora-Spanish phonological inventories, we address the understudied variety of monolingual Spanish spoken in Iquitos.

[6] The Yaguas represent a similar situation to that of the Bora communities in being a small group of indigenous language speakers who share a relatively unstudied Amazonian language of lowland Peru (Payne 1993).

The background of the participant data included in the present analysis is displayed in Table 1 below (see Table 2 in the appendix for data per speaker)[7]. In total we analyzed intervocalic stop realizations for 20 participants. The 10 speakers from the bilingual Bora-Spanish group come from the previously mentioned communities: Aconcolonia, Brillo Nuevo, and Nuevo Perú. In this group, there are 5 males and 5 females, with an overall average age of 38.9 years (*SD* = 13.6 years). The members of this group are relatively balanced bilinguals with high levels of oral fluency and literacy in both Spanish and Bora, as measured by participant self-report at the time of data collection[8]. The proficiency scale employed is based on numeric values from 0 to 4, whereby 0 is equivalent to no knowledge of the language in question, 1 signifies knowledge of basic vocabulary and greetings/fixed phrases, 2 is indicative of someone who can hold limited conversations and perform routine requests in the language, 3 represents an advanced command of the language but with some acknowledged limitations, and 4 is equivalent to a fluent native speaker of the language. A representation of this scale appears in Figure 2:

no knowledge > limited knowledge > functional knowledge > advanced knowledge > native
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0 1 2 3 4

Figure 2: Proficiency scale used to measure level of oral and reading proficiency

Table 1: Background information of participants in current study; average values from self-report on language ability with SD in parentheses

Group	Participants	Age	Bora Speaking	Bora Reading	Spanish Speaking	Spanish Reading
Bilingual Bora-Spanish Females	5	37.2 (9.4)	4.0 (0)	3.6 (0.9)	3.6 (0.5)	3.6 (0.5)
Bilingual Bora-Spanish Males	5	40.6 (17.9)	3.6 (0.9)	3.6 (0.9)	4.0 (0)	4.0 (0)
Monolingual Spanish Females	4	26.5 (12.6)	0 (0)	0 (0)	4.0 (0)	4.0 (0)
Monolingual Spanish Males	6	28.0 (7.4)	0 (0)	0 (0)	4.0 (0)	4.0 (0)

[7] While the Bora women worked in arts and crafts and maintained the household (i.e., a homemaker) or did not report a specific occupation, the Bora men were farmers and fishermen. In contrast, the Iquitos women reported working in tourism, as an ecologist and university student, a homemaker, and as a receptionist, while the Iquitos men were taxi drivers, a public administrator or ecology university students. As seen in Table 2 of the Appendix, Bora female participants were mostly from Aconcolonia (*N* = 4) and Brillo Nuevo (*N* = 1) while Bora male participants were from Brillo Nuevo (*N* = 3) and Nuevo Perú (*N* = 2). Some differences in education level between the groups were also observed: Bora speakers tended to have primary education and at most secondary education complete whereas Iquitos speakers tended to have secondary education complete and university-level studies in several cases (*N* = 5). These differences between groups may have contributed to the variation in linguistic behavior observed, in addition to several other factors. In a more expanded study, we intend to address these variables further since they may help explain our preliminary findings reported here in greater detail.

[8] Participants were instructed to use the 0–4 scale as explained to them by one of the principal investigators and President of the Yagua Federation, Manuel Ramírez López. They were asked to rate their oral and reading proficiencies based on this scale. In future collections we plan to use more detailed methods such as the Bilingual Language Profile (Birdsong, Gertken & Amengual 2012).

As shown in Table 1, Bora females rate themselves higher than the males in speaking ability in Bora, whereas these same females rate themselves lower than the males with respect to speaking and reading in Spanish. The monolingual Iquitos speakers, on the other hand, are a somewhat younger group, with an overall average age of 27.4 years (*SD* = 9.2); both males and females in the Iquitos group rate themselves as having native knowledge with respect to speaking and reading in Spanish, with no knowledge or speaking and reading ability in Bora or other indigenous languages.

2.2. Measurement and calculation

Recordings were analyzed using Praat (Boersma & Weenink 1992–2011). Segmentation of files was conducted using the waveform and spectrogram via auditory and visual inspection. For each of the voiced stops, the intensity minimum was measured along with the intensity maximum of the following vowel, both in decibels (dB). Figure 3 shows an example of this measurement. The intensity minimum of the consonant (C_{min}) was then compared to the vowel intensity maximum (V_{max}) in two ways. First, the absolute intensity difference (IntDiff) between the two was calculated as V_{max}-C_{min} in order to determine the intensity difference, as in Colantoni and Marinescu (2010). Greater differences are expected between less lenited variants (i.e., more stop and fricative-like realizations). Next, the relative ratio (IntRatio) of this local change in intensity was determined by dividing the drop in intensity during the consonant by the greatest intensity possible on the following vowel, or C_{min}/V_{max}, as in Hualde, Simonet and Nadeu (2011). In this way, a type of normalized measure is calculated and can be used as a point of comparison with all ratios being relative to 1; lower ratio values are expected for less lenited variants (or conversely high ratios closer to 1 indicate more approximant-like realizations). As discussed in Hualde et al. (2011), use of more than one measure may provide corroborating evidence for the measurement of constriction during lenition which may be sensitive to several linguistic factors, the role of which is still being determined. For example, in their study of Spanish stops, IntDiff and IntRatio showed a strong positive correlation (above $r = 0.9$), while each of these paired with duration showed a weaker correlation (below $r = 0.6$). They also note that of the three parameters examined by Parrell (2010), IntRatio showed the best correlation with measures of constriction from Electromagnetic Articulometry (EMA), when compared to IntDiff and MaxVel, another measure that finds faster increases in intensity correspond to greater degrees of lenition. In light of this previous research we employ IntDiff and IntRatio as two measurements to track intervocalic stop lenition in the Spanish of bilingual and monolingual speakers in the Peruvian Amazon.

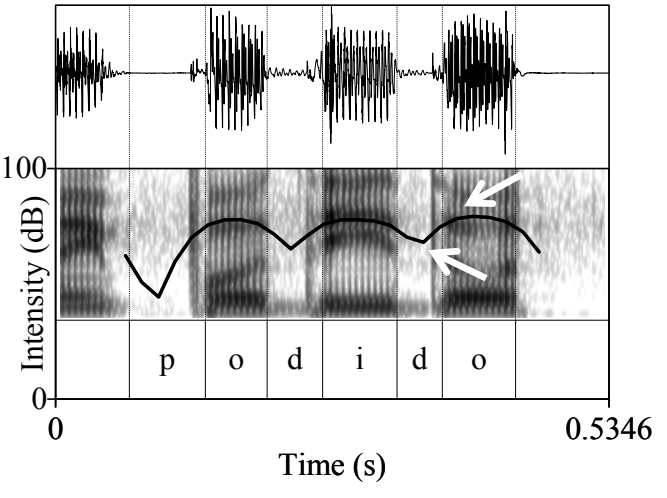

Figure 3: Sample spectrogram and intensity contour with consonant minimum and vowel maximum measurements indicated with arrows.

2.3. Database

The following results are based on the analysis of the first ten (10) tokens of voiced stops either between vowels or following a liquid /ɾ/ or /l/ since, as noted in Hualde et al. (2011: 308), lenition occurred historically in Spanish in those contexts as well. With 10 tokens per speaker x 3 stops x 10 speakers x 2 dialects, in total 597 word-internal[9] voiced stops were measured, including /b/=200, /d/=200, /g/=197[10]. Analyzed tokens come from both the sociolinguistic interviews and Pear Stories narrations.[11]

3. Results

In the discussion below, we report the findings of the calculations described above for the intensity difference (IntDiff) and intensity ratio (IntRatio) of the two speaker groups (corresponding data tables appear in the Appendix, Tables 3-6). Both measures have been included to facilitate cross-comparisons with prior research. To briefly summarize the IntDiff findings, the Iquitos speakers appear to be fairly homogenous between males and females with intensity differences mostly at 5 dB and below (N = 4, M = 4.92 dB, SD = 3.99 dB for females; N = 6, M = 3.67 dB, SD = 3.48 dB for males). However, the Bora-Spanish bilinguals (BS) demonstrate overall higher intensity differences, with the females all above 10 dB, producing a markedly higher IntDiff than the average difference for males in their own community (N = 5, M = 14.98 dB, SD = 7.02 dB for females; N = 5, M = 7.55 dB, SD = 5.40 dB for males), as well as for males and females in Iquitos noted above. The bilingual Bora-Spanish males, however, differ in that some speakers (BSm1 and BSm2) pattern with the other bilingual Bora-Spanish females, while the remaining bilingual Bora-Spanish males pattern with the monolingual Spanish Iquitos speakers (IqS).

To examine this behavior further, we determined the local intensity ratio in several steps. First, as seen in Figure 4, for these two dialects there are lower intensity ratios for the Bora-Spanish bilinguals compared to the Iquitos Spanish monolinguals. However, dividing groups according to gender, as in Figure 5, shows that bilingual Bora-Spanish females produce voiced stops with the least amount of lenition, compared to Iquitos monolingual Spanish females, whereas bilingual Bora-Spanish males are similar to Iquitos Spanish monolingual males. As with the IntDiff measure, individual differences can be observed, as shown in Figure 6 and Figure 7 for females and males respectively, with the first two bilingual Bora-Spanish males showing IntRatio values similar to bilingual Bora-Spanish females.

Last, the place of articulation was examined for both female and male speakers from both groups. In Figure 8 we can see some place differences for BS females in that /g/ shows more constriction (less lenition) and a wider range of values than the other two places. In Figure 9, BS males likewise show a wider range for /g/, although the median values (represented by the line in the middle of the boxplot) are closer to /b d/ than what appears for the BS females. While the Iquitos females and males show a greater constriction and slightly wider range of values for the velar compared to the other places of articulation, these differences are much less pronounced.

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[9] Since Face and Menke (2009) found significantly higher rates of lenition word-internally when compared to lenition of intervocalic stops across word boundaries, we have limited our tokens to word-internal intervocalic stops.

[10] Few tokens were observed for intervocalic /g/ in these speech samples.

[11] The number of tokens analyzed provides a first analysis of this phenomenon. As noted by one reviewer, a larger database is needed to more adequately describe the lenition processes under examination. Given the initial exploratory nature of this study, the present data set still allows for several observations to be made. Future study would entail an increased number of tokens per phoneme per speaker (as in Colantoni & Marinescu 2010) or an exhaustive analysis of all tokens within the interview (e.g., as in Hualde et al. 2011, Torreira & Ernestus 2011).

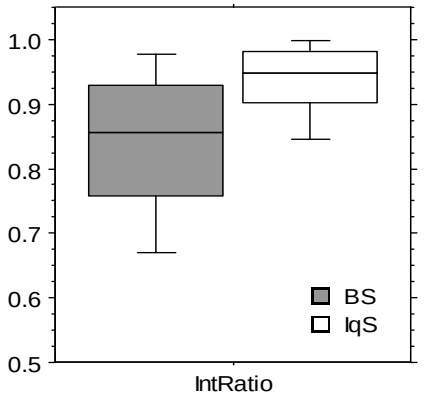

Figure 4: Intensity Ratio between dialects: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals

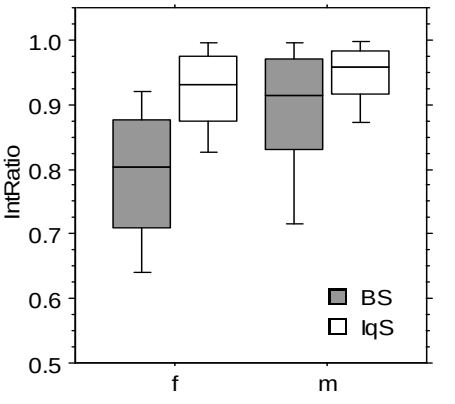

Figure 5: Intensity Ratio between dialects grouped by gender: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals; f=female, m=male

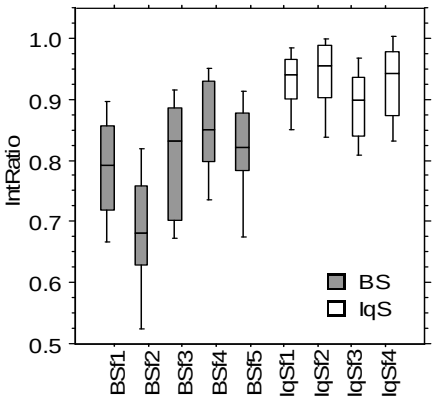

Figure 6: Intensity Ratio among *females*: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals

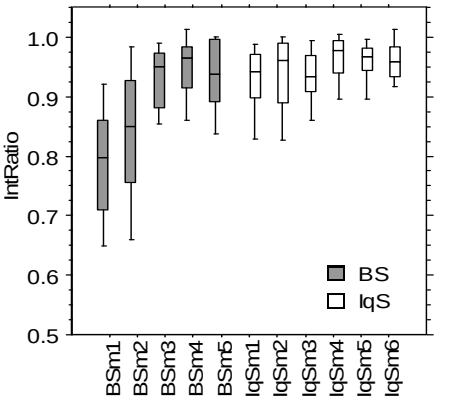

Figure 7: Intensity Ratio among *males*: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals

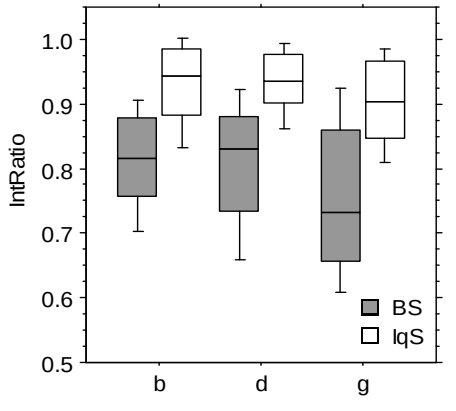

Figure 8: Intensity Ratio among *females* according to place of articulation: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals

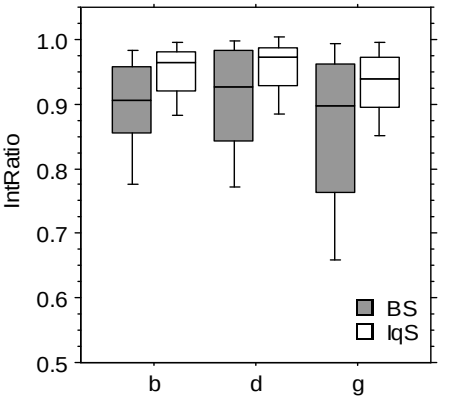

Figure 9: Intensity Ratio among *males* according to place of articulation: BS=Bora-Spanish bilinguals, IqS=Iquitos Spanish monolinguals

Statistical analysis of these variables shows significant differences between groups. To analyze the effect of dialect, gender, and phoneme, a generalized linear mixed model analysis (GLMM) was conducted in SPSS (Statistical Package for the Social Sciences) of Intensity Ratio (IntRatio) as the dependent variable with Dialect (Bora and Iquitos Spanish), Gender (male and female), and Phoneme (/b d g/) as fixed effects and Speaker as a randomized effect. A significant main effect was found for each of the independent variables: for Dialect, $F(1,16) = 18.444$, $p = 0.001$; for Gender, $F(1,16) = 7.164$, $p = 0.017$, and for Phoneme, $F(2,569) = 15.717$, $p = 0.000$. However, no interactions of fixed effects were found with this data set: Phoneme*Dialect $F(2,569) = 1.583$, $p = 0.206$; Phoneme*Gender $F(2,569) = 0.761$, $p = 0.468$; Dialect*Gender $F(1,16) = 2.706$, $p = 0.119$; Phoneme*Dialect*Gender $F(2,569) = 0.044$, $p = 0.957$. We expect that of the possible interactions, with a larger data set the interaction between Dialect and Gender as fixed factors may approach significance or become significant, as is suggested by the trend in the current data set. Post-hoc pairwise comparisons with a Bonferroni adjustment show that /g/ is significantly different from /b/ and /d/ ($p = 0.000$), whereas no significant difference was found between /b/ and /d/ ($p = 1.000$).

4. Discussion

From these data we can see that Bora-Spanish bilinguals as a group produce intervocalic voiced stops differently from Iquitos Spanish monolinguals, and that this difference was shown to be significant (see Figure 4). In addition, a significant difference was found between male and female speakers. The data show that while the BS group demonstrated greater differences between female and male speakers, with more lenition being observed among male speakers, the Iquitos Spanish group showed much less of a difference between female and male speakers, both displaying greater degrees of lenition compared to the BS female group (see Figures 5–7). This result is similar to that of Michnowicz (2011) who found that the male speakers of Yucatan Spanish in his study generally favored approximate variants of intervocalic stops while female speakers produced more occlusive variants. Limanni (2009) also observed the tendency for male speakers of Mexican Spanish to lenite more, as evidenced by shorter duration and slower consonant release, although this difference was not significant compared to females. An examination of the place of articulation shows that the velar phoneme behaves significantly different from the bilabial and dental phonemes (see Figures 8 and 9). These differences appear to be greatest for the BS females, followed by BS males; less of a difference is seen for Iquitos females and males, although these groups follow the same pattern to a lesser degree, with the median being lower for the velar than the other places of articulation in both cases. In this way, place asymmetries are more evident in BS. While the coronal was found to show the most lenition in terms of intensity in Colantoni and Marinescu (2010), the speakers in this study show similar degrees of lenition for both bilabials and coronals. Hualde, Simonet and Nadeu (2011) also found that velars were most similar in terms of intensity difference between /g/ and a voiced allophone of /k/; that is, the lenition of the voiceless velar approximated the voiced /g/ more closely than the other places of articulation. The data from the present study demonstrate that for these bilingual speakers, it is the velar which lags behind in the lenition process. Similarly, Carrasco (2008) also observed the greatest constriction with /g/ compared to /b d/ for Costa Rican Spanish voiced stops.

In this study, we observe that Spanish stop lenition is acquired differently in this bilingual situation in that we can see differences between genders, with several bilingual males showing more approximant-like realizations similar to males and females in the monolingual group. With greater self-reported fluency in Spanish, greater mobility and more extensive social networks, and potentially higher levels of education, the Bora males may be more exposed to non-Bora influenced Spanish.[12]

[12] This finding is potentially also linked to the role of men within the Bora communities: Bora men are the primary decision-makers within and across each clan and community; men do the hunting, fishing, gathering, and work in agriculture, sometimes leaving the home for several days, while women are engaged in house work and child rearing (Thiesen & Weber 2012); travel to larger cities by canoe or motorized boat is negotiated and undertaken predominantly by Bora males rather than females. All these interactions make it more likely that the men communicate more often with other inhabitants of the Amazon who do not speak Bora, making communication in Spanish a necessity, thereby increasing their input of more monolingual-like Spanish stops.

In addition, we have seen that a less lenited stop is produced by several speakers in the bilingual community, showing that voicing is acquired before lenition progresses to target-like forms. Finally, this study adds to the variety of spirantization that is found in the Spanish-speaking world. In comparison to previous studies, the Iquitos Spanish speakers and Bora-Spanish bilinguals show greater intensity differences than those reported for Argentine Spanish varieties (Colantoni & Marinescu 2010). In addition, the intensity difference and intensity ratios for the intervocalic voiced stops /b d g/ are similar in range to the voiced variants of /p t k/ reported in Hualde, Simonet, and Nadeu (2011), in particular for BS females and some males. That is, the Bora-Spanish bilingual speakers' /b d g/ is still behaving similarly to a voiced /p t k/. Based on these data, we can propose that the first step for these Bora speakers in their reorganization of a contrast in stops is to voice their simple voiceless stops /p t k/ before losing the aspiration of the voiceless aspirated stops /p^h t^h k^h/. This order of events may be considered somewhat similar to one of the theories of stop lenition from Latin to Spanish; that is, voiceless stops became voiced, which allowed the simplification of voiceless geminate stops to become singletons (see discussion in Lloyd 1987: 143-148). An alternative sequence for Bora speakers learning Spanish would be that the aspirated stops become simple stops in a push-chain, thus losing the two-way contrast with aspiration, which then causes the simple stops to become voiced. However, support for voicing to develop first is found in that the aspirated stop is still employed in the Spanish of the bilingual speakers (see Figure 1), often in stressed position and with the voiceless velar stop. A separate analysis of intervocalic stops in Bora would help support these observations by determining the allophonic variation in present-day Bora.

Several other factors which have been shown to affect stop lenition should also be taken into consideration such as vowel quality before and after the stop, preceding consonantal segment, stress position, duration, word boundary, and word frequency (Carrasco 2008, Colantoni & Marinescu 2010, Cole, Hualde & Iskarous 1999, Eddington 2011, Ortega-Llebaria 2004, Parrell 2011, among others). For example, in these studies a preceding /s/ contributed to greater constriction followed by other more sonorant segments such as liquids and glides, as did stressed syllables, word-initial position (compared to word-internal segments), phrase-boundary (compared to word-boundary); conversely shorter durations, and higher word frequency contributed to less constriction, as did atonic stress. In particular with respect to velars, Cole, Hualde and Iskarous (1999) examined stress and vowel quality with respect to /g/ spirantization and found more lenition in post-tonic syllable onset, and with back high vowels /o u/ preceding and following /g/, which the authors suggest may be due to the fact that the tongue body does not need to move for back vowels (in comparison to other low and front vowels), therefore minimizing the constriction during the production of the consonant. Ortega-Llebaria's (2004) study corroborates these findings for unstressed syllables and back vowels; in addition, she finds that /g/ preceding /i/ with a palatal point of articulation will likewise have a small amount of tongue body movement and therefore a low degree of consonant constriction. Colantoni and Marinescu (2010) also find the least amount of lenition for /g/ followed by /e/ or /a/, and that stress inhibited lenition. Other extralinguistic factors, such as age, may also need to be considered in more detail, for example as in Michnowicz (2011), which found that younger bilingual Maya-Spanish speakers favored more approximant-like realizations. With a larger database, these factors can be examined more in depth to better account for the range of voiced stop lenition present in the Spanish spoken by monolinguals and bilinguals in the Peruvian Amazonian.

In this way, the analysis of intensity alone depicts only a portion of the factors that may influence stop production. In order to fully depict how lenition may differ between groups of speakers, other additional factors need to be considered, such as speaking rate, degree of fluency of the speaker, as well as prosodic position within the word and the utterance. In particular, it is expected that faster speaking rates will show a reduction in the amount of constriction during the stop (i.e., reduced intensity drop and intensity ratios closer to 1). The fluency of the speaker may affect this speaking rate, with those more fluent in Spanish showing faster rates, and those who are more Bora-dominant showing slower rates. In this way, the influence from Bora in producing Bora-like occlusion of stops between vowels could be indirect, in that there is simply more time for occlusion during the stop (in addition to the potential direct transfer of full stops from Bora). Bora-Spanish bilinguals may also vary

in the amount of input they receive with regard to stop lenition in Spanish. That is, a measure of the frequency and length of exposure to other communities of Spanish speakers (both monolinguals and bilinguals from other indigenous language communities) who may show more lenition (e.g., through travel to near-by towns for commerce, contact with Iquitos Spanish, exposure to radio and other media/music), would help to further differentiate speakers.

Even the role of orthography may need to be examined. Bilinguals with some education in both Bora and Spanish writing systems need to keep the grapheme-to-phoneme correspondence separate for each language in that <b>, <d>, and <g> represent non-aspirated voiceless stops in Bora but voiced stops in Spanish; in addition <v> represents a separate bilabial voiced fricative phoneme in Bora, but represents the bilabial voiced phoneme in Spanish, which varies in manner according to position from a full stop to an approximant. An analysis of writing in both of these languages, including a task of writing nonce words, would demonstrate how bilinguals differentiate voiceless and voiced stops, fricatives, and approximants in each of these languages. In addition, it would be useful to show if the presence of the voiced bilabial fricative in Bora facilitates learning the lenition process in Spanish, which would predict an asymmetry in the development of the behavior, with bilabials showing lenition earlier than the other places of articulation. An alternate path of acquisition might transpire as bilinguals begin to further differentiate the two languages, which would predict either that bilabials would become approximants more quickly than the other places, or that bilabials would lag behind approximant production in the other places, since the bilabial fricative would already be non-stop-like. These differences may occur at the individual level, but also at the community-wide level in terms of which allophones are most commonly used in a given context by the majority of bilingual speakers. Ortega-Llebaria (2004) notes similar inventory constraints on the degree to which lenition may occur in English as compared to Spanish, the former of which has a voiced labiodental fricative phoneme /v/ compared to the latter which does not. In Face and Menke (2009), English-speaking learners of Spanish predominantly showed the realization of intervocalic /b d ɡ/ as stops but later increased spirantization rates were found at higher proficiency levels, with stress, orthographic /v/, and position within the word also influencing the pronunciation of voiced obstruents. Of the three places of articulation, /ɡ/ showed the lowest rates of realization as an approximant for graduating Spanish majors and Ph.D. students; among fourth semester students, approximant realization was lowest for /d/, followed by /ɡ/ and then /b/ (Face & Menke 2009; see Simonet 2012 for additional discussion). Also in their study, fricatives, which showed low rates overall for second language (L2) Spanish learners, were higher for orthographic <v>. In light of these findings, we may expect Bora-Spanish bilinguals to demonstrate more stop-like realizations at lower levels of proficiency, with increased rates of spirantization at higher levels; we might likewise predict some asymmetry in lenition rates for the bilabial stop /b/ due to phonemic inventory and orthographic differences between Bora and Spanish. Nonetheless, in the current analysis of the data, this distinction of /b/ compared to the other places of articulation does not bear out.

It must also be noted that while we hypothesize that the specific contact situation with Bora as a source language has influenced the non-target-like production of stops in Spanish, we acknowledge the possibility that this behavior is more characteristic of incomplete second language acquisition and not necessarily the result of direct transfer. Recent research suggests that in studies of language contact it is important to evaluate the constraints on acquisition such as interlanguage processing (Plag 2013). Other contact varieties, such as Yucatan Spanish, which has been in prolonged contact with the indigenous language Maya, also display voiced stops [b d g] in contexts where standard Spanish varieties would favor an approximate [β ð ɣ] (Michnowicz 2011). Michnowicz (2009) compares Yucatan Spanish to other contact varieties and concludes that non-spirantized stop production of [b d g] in Yucatan Spanish is the result of incomplete acquisition and not of direct influence from Maya. Additionally, if we consider that the acquisition of Spanish fricatives by adult native English-speakers has illustrated that learners have difficulty in acquiring these segments (see Face & Menke 2009, Díaz-Campos 2013), and that they show levels of spirantization much lower than monolingual Spanish (e.g., Zampini 1994), then these findings make future studies of contact varieties of Spanish and indigenous languages necessary in order to answer whether our results are more characteristic of language transfer from Bora or interlanguage development.

5. Conclusion

This study demonstrates behavioral differences in the production of intervocalic voiced stops in Spanish in the Peruvian Amazon. It has been shown that Bora speakers who are bilingual in Spanish produce intervocalic voiced stops with greater degrees of constriction than monolingual speakers from Iquitos. Further differences were observed with female Bora speakers showing the least amount of lenition and velar stops also showing more constriction than other places of articulation. However, as previously noted, several other segmental, prosodic, and word frequency factors may also contribute to this variation. An examination of the lenition of voiceless stops as produced by Bora-Spanish bilinguals and Iquitos Spanish monolinguals may further demonstrate how these bilinguals achieve local and regional targets in the development of the system of Spanish stops. In any case, the present study adds to the field by providing an experimental analysis of intervocalic voiced stop realization in an understudied region of the Spanish-speaking world.

Appendix

Table 2. Background information of participants in current study; BS = Bora-Spanish, IqS=Iquitos Spanish; f=female, m=male

Speaker	Sex	Origen	Education	Age	Bora Spoken	Bora Literacy	Spanish Spoken	Spanish Literacy
BSf1	f	Aconcolonia	NA	31	4	4	4	4
BSf2	f	Aconcolonia	NA	52	4	4	3	3
BSf3	f	Aconcolonia	Secondary complete	40	4	4	4	4
BSf4	f	Brillo Nuevo	1st yr. sec complete	35	4	2	4	4
BSf5	f	Aconcolonia	NA	28	4	4	3	3
BSm1	m	Brillo Nuevo	Primary complete	59	4	4	4	4
BSm2	m	Brillo Nuevo	Primary complete	56	4	4	4	4
BSm3	m	Brillo Nuevo	5th grade Secondary	22	4	4	4	4
BSm4	m	Nuevo Perú	Primary complete	44	4	4	4	4
BSm5	m	Nuevo Perú	4th year Secondary	22	2	2	4	4
IqSf1	f	Iquitos	University	18	0	0	4	4
IqSf2	f	Iquitos	2.5 yrs. University	19	0	0	4	4
IqSf3	f	Iquitos	Secondary complete	45	0	0	4	4
IqSf4	f	Iquitos	Secondary complete + Certification.	24	0	0	4	4
IqSm1	m	Iquitos	University complete	28	0	0	4	4
IqSm2	m	Iquitos	Secondary complete	36	0	0	4	4
IqSm3	m	Iquitos	5th grade Secondary	27	0	0	4	4
IqSm4	m	Iquitos	NA	37	0	0	4	4

Speaker	Sex	Origen	Education	Age	Bora Spoken	Bora Literacy	Spanish Spoken	Spanish Literacy
IqSm5	m	Iquitos	3rd year University	19	0	0	4	4
IqSm6	m	Iquitos	4th year University	21	0	0	4	4

Table 3. Intensity Difference per speaker; BS = Bora-Spanish, IqS=Iquitos Spanish; f=female, m=male

Speaker	N	Mean IntDiff (dB)	SD	Speaker	N	Mean IntDiff (dB)	SD
BSf1	30	17.10	7.68	IqSf1	30	4.72	3.87
BSf2	30	20.73	7.89	IqSf2	30	3.69	3.95
BSf3	28	13.82	7.66	IqSf3	30	6.60	3.84
BSf4	29	10.35	5.88	IqSf4	30	4.66	4.30
BSf5	30	12.89	6.00	IqSm1	30	4.90	4.12
BSm1	30	13.74	6.67	IqSm2	30	4.17	4.62
BSm2	30	11.12	7.91	IqSm3	30	4.94	4.26
BSm3	30	4.82	4.48	IqSm4	30	2.71	3.38
BSm4	30	3.34	3.61	IqSm5	30	3.02	2.57
BSm5	30	4.71	4.33	IqSm6	30	2.26	1.90

Table 4. Intensity Ratio according to dialect, grouped by gender; BS = Bora-Spanish, IqS=Iquitos Spanish; f=female, m=male

Dialect	N	Mean IntRatio	SD	Dialect	N	Mean IntRatio	SD
BS, total	297	0.836	0.119	IqS, total	300	0.935	0.060
BS, f	147	0.788	0.111	IqS, f	120	0.921	0.064
BS, m	150	0.884	0.106	IqS, m	180	0.944	0.055

Table 5. Intensity Ratio according to dialect, grouped by gender and individual speaker; BS = Bora-Spanish, IqS=Iquitos Spanish; f=female, m=male

Speaker	N	Mean IntRatio	SD	Speaker	N	Mean IntRatio	SD
BSf1	30	0.781	0.097	IqSf1	30	0.926	0.058
BSf2	30	0.681	0.109	IqSf2	30	0.936	0.068
BSf3	28	0.810	0.101	IqSf3	30	0.894	0.058
BSf4	29	0.854	0.082	IqSf4	30	0.927	0.067
BSf5	30	0.815	0.086	IqSm1	30	0.926	0.060
BSm1	30	0.789	0.100	IqSm2	30	0.935	0.068
BSm2	30	0.828	0.126	IqSm3	30	0.928	0.061
BSm3	30	0.926	0.065	IqSm4	30	0.957	0.053
BSm4	30	0.947	0.055	IqSm5	30	0.956	0.038
BSm5	30	0.933	0.060	IqSm6	30	0.961	0.033

Table 6. Intensity Ratio according to place of articulation, grouped by dialect and gender; BS = Bora-Spanish, IqS=Iquitos Spanish; f=female, m=male

Dialect, Gender	/b/ N	Mean IntRatio	SD	/d/ N	Mean IntRatio	SD	/g/ N	Mean IntRatio	SD
BS, f	50	0.810	0.086	50	0.802	0.111	47	0.748	0.126
IqS, f	40	0.931	0.060	40	0.930	0.058	40	0.901	0.070
BS, m	50	0.895	0.078	50	0.900	0.100	50	0.858	0.131
IqS, m	60	0.946	0.057	60	0.955	0.050	60	0.930	0.056

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