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¿Soy de Ribera o Rivera?: Sociolinguistic /b/-/v/ Variation in Rivera Spanish

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Abstract: This study investigates the impact of language contact on three generations of bilingual Spanish and Uruguayan Portuguese speakers in Rivera City, Uruguay, located on the Uruguayan–Brazilian border. Focusing on the confirmed presence of the Portuguese-like/b/and/v/phonemic distinction, and the lower frequency of the Montevideo Spanish-like approximantized stops in Riverense Spanish (RS), the research examines the production of <v> and <b> in 29 female Rivera Spanish bilinguals belonging to different age groups. More specifically, the aim was to see if the previously observed differential use of language-specific phonological variants could be accounted for by using precise measurements of relative intensity, duration, and voicing coupled with a distributional analysis of realizations derived from auditory coding. At the same time, their production is compared to that of 30 monolingual Montevideo Spanish (MS) speakers, who served as the control group, offering a first description of the production of <v> and <b> within this distinct Rioplatense Spanish variety. Riverense's higher overall relative intensity, duration, and voicing values support auditory coding results, providing evidence of the expected phonological differences between both Uruguayan Spanish varieties. In particular, an exclusive presence of fricative/v/and less approximantization of/b/in RS speech exposed the influence of Portuguese in Rivera bilinguals and their divergence from MS. In addition, as predicted, the findings reveal a higher presence of Portuguese-like productions of [v] and [b] in older bilinguals when compared to younger generations. This illustrates a continuum from Portuguese-like forms to Spanish-like forms, which is confirmed by both acoustic and distributional analyses. Finally, evidence of the existence of innovative forms resulting from mixing Portuguese and Spanish phonological systems in RS are presented. This study's findings contribute to sociolinguistics and bilingualism by exposing cross-linguistic influence in a border setting with rigorous analytical methods that offer reliable results and go beyond a basic analysis based on auditory identification.

Keywords: sociolinguistics; phonetics and phonology; languages in contact; speech production; border linguistics; bilingualism; bilingual variation; Riverense Spanish; Montevideo Spanish; Uruguayan Spanish

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1. Introduction

1.1. Research Context

Uruguay is commonly known as a Spanish-speaking nation that belongs to the Rioplatense dialectal region. However, the significant presence of Portuguese in the border cities of Uruguay and Brazil is less well-known. The border between Uruguay and Brazil is remarkably porous, fostering profound linguistic interaction between Portuguese and Spanish since the early stages of European colonization (Bertolotti and Coll 2020, p. 2). Bilingualism in Spanish and Portuguese is prevalent within these border communities, where both languages are employed in daily communication (Carvalho 2003, 2016; Behares 1984; Elizaincín et al. 1987; Waltermire 2011).

The prevailing perception of Uruguayan Portuguese (UP), among border bilinguals from these locations, as a mixed language and that of Montevideo Spanish (MS) as the "pure prestige national model" influences language choices that typically favor Spanish, especially in situations of public life, and masks a deep sense of shame for their own Portuguese. As Carvalho (2003, 2014) explains, this inclination is particularly noticeable among upper-class young urban bilinguals, due to an acute sense of stigmatization that they feel as a result of their Uruguayan Portuguese (UP). Although mixed identities do not necessarily indicate a mixed language, and variability is not indicative of error, linguistic uncertainty is an inherent aspect of life in all border communities. This leads to Rivera bilinguals' linguistic choices existing on a spectrum from Spanish-like to Portuguese-like, depending on social context. This is especially true in Rivera, which stands out as the most densely populated economic center, sharing an open border with Santana do Livramento, Brazil (Figure 1).

(**a**) (**b**)

Figure 1. (**a**) Map of Uruguay with Rivera marked in red and Montevideo in blue; (**b**) urban map of Rivera with main cities, roads, and surrounding locations.

The stigma against Uruguayan Portuguese also extends to the Spanish spoken at the border. Through a series of sociolinguistic interviews, Carvalho (2006) has shown that the labiodentalization of/b/, alongside other variants such as the presence of Portuguese-like full sibilants over the typical Montevidean aspiration, is subject to heavy stigmatization among Riverans. It contributes to the perception of border Spanish as what has often been defined by its own speakers as "less correct" and "shameful", and that of Montevidean Spanish as more prestigious and accurate. To illustrate this, some participants in Carvalho (2006, pp. 89–90) claimed:

- "El español de Rivera es deformado por el portugués" (Js Ig). *The Spanish from Rivera has been deformed by Portuguese.*
- "Es diferente, es distinto. La pronunciación de ciertos sonidos, la/s/, la/v/que el montevideano no pronuncia para nada, y nosotros sí. Vas a Montevideo y enseguida te dicen, ¿Sos de Rivera?" (AM). *It is different, it is distinctive. The pronunciation of certain sounds like the/s/, the/v/, Montevideans do not pronounce them at all, but we do. You go to Montevideo and immediately they ask you, Are you from Rivera? Because it's different'.*
- "Ellos allá dicen vo(h), nosotros vo(s)" (Mrg). *There they say vo(h) [you sing. with final-s aspiration], we say vo(s) [you sing. with final full sibilant].*
- "Ahora trato, lógico, de corregirme, porque como todos se ríen, viste… sobre todo la gente del sur, que dicen que los Riverenses acentuamos las eses y las uves. Entonces, cuando uno va a hablar, trato de decir Ri[β]era. Incluso cuando estoy acá, pues antes no me daba cuenta que decía Ri[v]era, nosotro[s], vo[s] (Co). *'Now I try, obviously, to correct myself, because they mock me, you know, especially people from the South, who say that we Riverans mark the Ss and the* Vs. *So, when we speak, I try to say Ri[β]era, even when I am*

here, while in the past I was not aware that I used to say Ri[v]era, nosotro (s) [we pl. pronoun], vo(s) [you sing. pronoun].

Numerous studies have explored lexical, morphological, phonological, and recently also prosodic variation in Uruguayan–Brazilian bilinguals (i.e., Rona 1965; Elizaincín 1976; Elizaincín et al. 1987; Hensey 1972, 1982; Carvalho 1998, 2004, 2006, 2016, 2019, 2021; Waltermire 2008, 2010, 2011, 2012; Machado 2024), revealing that their speech is non-static; it moves along a linguistic continuum between monolingual Spanish and Portuguese (Waltermire 2012) determined by various factors including age, gender, socioeconomic background, rural vs. urban origin, place of residence, identity, and context of interaction, among others.

Several previous studies have investigated the sociolinguistic distribution of consonants in Uruguayan–Brazilian-border Spanish, exposing the dynamicity of their bilingual repertoire. Among them, some have focused specifically on their production of stops; for instance, Waltermire (2008, 2010) examined how sociolinguistic factors, such as age, gender, occupation, and attitudinal factors influence the realization of intervocalic/d/as an approximant, null, or occlusive in Rivera bilinguals' Spanish. These studies found that Uruguayan Portuguese-dominant speakers incorporated standard Brazilian Portuguese occlusive realizations of/d/into Spanish more than Riverense Spanish-dominant speakers. Spanish-preferring speakers, who were usually the youngest, exhibited a higher frequency of approximant or null variants, with the former sound serving as a prestige marker, while occlusives were favored by first- and second-generation non-professionals of Portuguese-dominant background. Interestingly, younger bilinguals, who exhibited the most positive attitude toward mixing variants, were observed to lead linguistic change.

Subsequent studies by Waltermire and Gradoville (2020), and Gradoville et al. (2021) further emphasized Portuguese influence on Uruguayan-border Spanish, noting a cognate effect in the degree of constriction of intervocalic/d/; the frequency of Portuguese cognates and their similarity to Spanish forms were found to significantly influence Riverense Spanish speakers. This influence led to less consonant constriction that aligned more closely with Uruguayan Spanish standards, favoring the approximantization typical of Montevideo Spanish.

Even more recently, in a more comprehensive study, Waltermire (2023) studied the influence of Portuguese on the production of intervocalic/b//d/and/g/in the Spanish of Rivera bilinguals to determine the role of age, gender, occupation, and attitudes. A direct relationship between the use of Portuguese articulations (stops [b] [d] and [g], and fricative [v]) in their Spanish and social/demographic factors was found; in particular, the strongest presence of Portuguese-like productions was seen in older bilinguals, females, service workers, and bilinguals with positive attitudes towards local Portuguese. Although the results in this study reveal distinct correlations, it is crucial to note that findings in this study rely on perceptual analysis alone, as no acoustic–phonetic measures were employed to document variations.

Considering all this, our study's main aim is to expand on the knowledge of Rivera Spanish production of the graphemes <v> and <b>, to see whether we can trace the previously attested influence of Portuguese and generational trends by performing a more meticulous analysis using acoustic–phonetic measures. With all this, we intend to add to the body of studies that show that Portuguese–Spanish switches in phonology attest to cross-linguistic influences between both languages, potentially independently of code-switching. We hope to demonstrate along with the existing literature on local varieties that the Spanish spoken in Uruguay is not a monolithic entity in that (a) contact-induced features are effectively present and clearly measurable in the Spanish of its border, (b) the presence of these features is identity-affiliated and that this can be observed through a cross-generational analysis.

1.2. Studies on <b> and <v> Production: Towards a Better Understanding of Its Behavior

While in languages such as Portuguese or English the <b> and <v> graphemes represent different sounds, in Spanish this distinction is usually not present. As detailed in Helms et al. (2022), Spanish underwent a historical process of neutralization of/b/and/v/ into an approximant sound [β] in certain contexts (not attested in Brazilian Portuguese), leaving Spanish with the only possibility of producing a full stop [b] or a lenited [β] sound for these graphemes. In Spanish, traditional accounts such as that of Morgan (2010) state that only [b] and [β] can be expected for <v> and <b>. More specifically, [b] is realized in utterance initial positions (i.e., "**v**enden" (*they sell*) as [ˈben.den]) and after nasal consonants (i.e., "e**nv**olvemos" (*we wrap*) as [em.bol.ˈβe.mos]), while [β] is produced intervocalically (i.e., "est**aba**" (*I was*) as [es.ˈta.βa] or "**ave**" (*bird*) as [a.ˈβe]) and after other sounds such as rhotics and laterals (i.e., "á**rb**ol" (*tree*) as [ˈaɾ.βol] and "a**lb**óndiga" (*meatball*) as [al.ˈβon.di.ɣa].

Despite this, several studies have shown that the labiodental fricative [v] is present in certain Spanish varieties (i.e., Stevens 2000; Takawaki 2012; Hualde 2014; Chappell 2020; Ortega 2018; Torres Cacoullos and Ferreira 2000; Sadowsky 2010; Trovato 2017; Helms et al. 2022) as either (a) as a relic variant, (b) the result of hypercorrection, (c) the result of coarticulatory assimilation, (d) the result of language contact, or (e) linguistic change and innovation. With respect to the last cause, for instance, Sadowsky (2010) has specifically argued that Chilean Spanish speakers produce [ʋ], an approximant variant of [v] as an innovative form that probably derived from the detriment of bilabial fricative [β]. Although findings in this study derive solely from the audiovisual analysis of articulatory patterns in participants, they prove that accounting for the pronunciation of <v> and <b> requires an accurate and more precise analytical strategy beyond auditory judgments.

Recent studies have analyzed variation in the pronunciation of/v/and/or/b/across languages, including Spanish, utilizing acoustic–phonetic measures such as relative intensity (intensity difference in decibels between the consonant and its following vowel) (RI), percentage of voicing, and duration (in milliseconds), proving they can be reliable metrics to account for differences and that they interact with each other (i.e., Colantoni and Marinescu 2010; Trovato 2017; Ortega 2018; Helms et al. 2022; Afshar 2022).

In the context of contact varieties in particular, Trovato (2017) analyzed/b/variation in Texas Spanish to show the effects of language contact in labiodentalization of thirty bilingual speakers from the borderland city, El Paso (Texas, US), where Spanish and English are in constant interaction. More specifically, the main aim was to study what sociolinguistic factors condition the use and distribution of the labiodental fricative [v]; a standard realization of <v> in English but not in Spanish. An auditory and acoustic examination revealed that the phoneme/b/was commonly articulated as a labiodental fricative [v] in 30% of occurrences, mostly in instances where <v> was spelled and was in the medial position in the word. This substitution was particularly prevalent among female speakers, who exhibited it roughly 50% more frequently than their male counterparts, as well as among individuals with a higher level of written proficiency in English and lower one in Spanish. Statistical analyses confirmed relative intensity and duration as the best acoustic predictors over center of gravity, proving there are measurable differences in the pronunciation of/b/in this community. As hypothesized, based on constriction, the labiodental fricative [v] exhibited a greater intensity difference with the following vowel, compared to bilabial segments (consonants with a +1 incremental difference in intensity were 18.4% more likely to be perceived as labiodentalized). At the same time, as expected based on manner of articulation, the duration of [v] was proven to be longer, especially in word-initial position. The strong statistically significant correlation found between duration and position observed suggests that duration is a reliable acoustic indicator for distinguishing between bilabial and labiodental consonants, especially in word-initial position (Trovato 2017, p. 101). Finally, cognate status, stress, adjacent phonemes, and lexical frequency did not show any statistical significance.

In a related study, Ortega (2018) investigated the occurrence of [v] as a variant of/b/in El Paso Spanish among three distinct groups of Spanish–English bilinguals (N = 31), categorized by their age of arrival, duration of exposure to language contact, and English proficiency. This was intended to confirm that the presence of the labiodental fricative is indeed a result of contact with English. The results show that [v] was more frequent among speakers with a higher degree of English contact (24.5%) and English proficiency (12.1%), in intermediate and advanced heritage groups, especially among females. Unlike Trovato (2017), stress did show a significant correlation with the occurrence of the labiodental variant in this study, a result possibly favored by employing a spontaneous task. As predicted, stressed syllables favored [v] due to an articulatory strengthening process, as opposed to [β], which occurred more frequently in unstressed syllables. In addition, and contrary to the findings of previous studies (Sadowsky 2010; Vergara 2013; Takawaki 2012; Trovato 2017), the results showed that labiodental fricativization was more frequently present in the initial rather than the word-medial position; possibly resulting from an emphatic pragmatic technique participants used in the narration of the children's story while performing tasks. Like [b] but at a lower rate, [v] was more prevalent when occurring without a preceding segment (35%) or following consonants (18.3%), whereas [β] was predominantly observed after vowels (99%), but was also notably present after consonants (55.7%) and in the absence of a preceding segment (16.2%). The following segment did not yield significant results. Finally, like in Trovato (2017), Ortega's findings confirm that relative intensity (RI) and duration serve as reliable predictors. As depicted in Table 1 (Table 2.4 in Ortega 2018, p. 42), the stop [b] displays a lower mean RI compared to [v], which challenges Hualde et al.'s (2011) notion that sounds with higher degrees of constriction exhibit higher levels of relative intensity.

Table 1. Table 2.4 in Ortega (2018, p. 42) depicting results for duration and relative intensity.

/b/variants	Stop [b]	Approximant [β]	Fricative [v]
Mean Duration	26 ms	30 ms	59 ms
Mean Relative Intensity	−4.4 db	−2.6 db	−6.9 db

Based on this, Ortega argues that relative intensity correlates not only with the degree of constriction, but also with the level of articulation, as suggested by Carrasco et al. (2012). In this respect, the results stem from the premise that sounds that require less articulatory effort, such as [b], exhibit a smaller relative intensity difference with the following vowel than those that require more effort, such as [v]. Building on these findings, the approximant variant [β] was observed to display the smallest intensity difference, as anticipated. This aligns with the findings of Colantoni and Marinescu's (2010) analysis of stop weakening in Argentine Spanish, which indicates that the less constricted the stop, the smaller the intensity difference. Consequently, [β] tends to approach 0 dB, positioning it at the furthest end of the RI continuum from [v].

It is important to note that, apart from RI and duration, Colantoni and Marinescu (2010) also measure voicing to assess the degree of lenition of stops. They expected that more lenited variants would demonstrate a higher percentage of voicing compared to less lenited ones (Figure 2); although the correlation between the type of stops and percentage of voicing was not significant, voiceless stops showed very little signs of voicing as expected, except in one speaker who produced 60% of voicing of the total duration of voiceless stops (Colantoni and Marinescu 2010, p. 105). This highlights that voicing can be instrumental in predicting stop consonant variation, particularly in cases of lenition. Quantitative studies that include the analysis of [v] voicing are scarce (i.e., Jekiel 2012) and none directly compare it to its variants [b] and/or [β]. We know, however, that its continuous airflow enables more consistent vocal cord vibration; the narrow passage in [v] facilitates sustained voicing, while the complete closure in [b] interrupts its voicing, typically resuming after release.

Though [β] allows partial airflow, it may not sustain voicing as consistently as [v] due to less turbulent airflow.

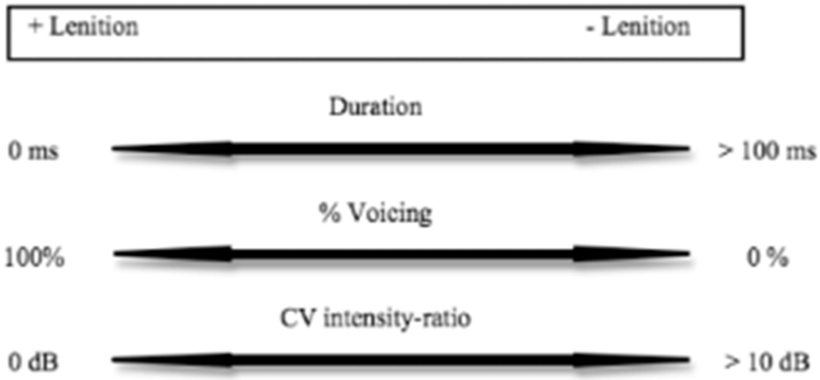


Figure 2. Figure 2 in Colantoni and Marinescu (2010, p. 103) depicting predictions for all measured acoustic parameters to calculate degree of lenition in Argentine Spanish.

Considering all this, the questions that guide our research are:

1. Are there measurable differences between the production of <v> and <b> of Rivera Spanish and Montevideo Spanish? What acoustic measures better portray these differences?
2. Can we trace cross-generational differences within RS? Which measures portray these differences better?

1.3. Hypotheses

In this study, we predict that:

1. Rivera bilinguals will differ from Montevideo monolinguals, producing more Portuguese-like variants that will be exposed by their distinctive relative intensity, duration, and voicing.
2. Older generations will diverge more from the expected targets, resulting from the stronger influence of Portuguese in their speech and from their stronger local identity.

2. Materials and Methods

2.1. Participants

This study encompassed a total of 59 female speakers of Uruguayan Spanish, divided into two groups; no males were tested due to availability constraints. The first group consisted of 30 Montevideo Spanish monolinguals, while the second comprised 29 Spanish–Uruguayan Portuguese bilinguals from Rivera City, Uruguay. The bilingual participants were further categorized into three generational groups: the first generation (≥64 years old), the second generation (31 to 63 years old), and the third generation (18 to 30 years old). These generational divisions were established based on local lifestyle, age-specific attributes related to social norms and identity, language utilization, and socio-historical events. It is worth noting that these criteria slightly deviate from the age-grouping standards applied in previous sociolinguistic studies on Rivera (i.e., Carvalho 2004, 2014, 2020; Waltermire 2011, 2012, 2023; Waltermire and Gradoville 2020; Gradoville et al. 2021) (see Table 2).

Table 2. Summary of criteria for generational grouping.

Generation	Characteristics	Language Use
1	- Deep rural ties - Retired bilinguals - Usually, grandparents - Strong local identity	- Strong proficiency, dominance, and use of UP - UP is their preferred language

Table 2. *Cont.*

Generation	Characteristics	Language Use
2	- Active social/work life - Usually parents - Weaker local identity - Often, mixed-heritage rejection	- Mostly "hidden" balanced bilinguals - UP proficient: mostly used in private settings, at home - Spanish preferred due to stigmatization of UP in public
3	- Youngest adult bilinguals - Active social and cultural life - Even weaker local identity: identify more as Uruguayan than Riverense - Recently immersed in working life or in tertiary studies - Usually, recent parents with young children, or single	- Spanish dominant with low to moderate UP proficiency - Restricted UP use, prefer Spanish inside and outside the home - Excludes specific educational and passive learner categories

2.2. Stimuli

On average, each participant in the study produced approximately 40 tokens. The total number of tokens analyzed was 2353 (RS = 1164 and MS = 1188). Stimuli included one- to four-syllable words that contained graphemes <v> and <b>, as seen in the examples given in Table 3 below.

Table 3. Examples of stimuli.

Stimulus	Target in Spanish	Grapheme
'baje	[b]	<b>
'vamos	[b]	<v>
Compraron ce'**b**ollas	[β]	<b>
Dónde **'v**iven	[β]	<v>
Dónde 'vi**v**en	[β]	<v>
Vol'vieron temprano	[β]	<v>
Vol'**v**ieron temprano	[β]	<v>
En**v**ol'vemos todo	[β]	<v>
Envol'**v**emos todo	[β]	<v>
Compramos 'yer**b**a	[β]	<b>
Cuántas '**v**ieron	[β]	<b>

Words were embedded into sentences that belonged to different types: yes or no questions (YN), statements (SS), tag questions (TQ), WH-questions (WH), and imperatives (IMP) (Table 4). While sentence types were not specifically controlled for, the decision to use sentences instead of individual words to trigger the expected sounds was made, to capture more authentic constructions infused with Uruguayan cultural content. This approach facilitates the exploration of the complex interplay between cultural and phonological factors, providing a better understanding of the diverse realizations of [b] and [v] by speakers of both Uruguayan Spanish varieties within authentic language constructions. A list of all stimuli can be found in Appendix A.

Table 4. Examples of sentences.

YN	SS	TQ	WH	IMP
¿Compraron **b**ananas? *Buy.3rdpl.inf.pres. bananas?*	Compraron **b**ananas *Buy.3rdpl.inf.pres. bananas*	Compraron **b**ananas, ¿cierto?/¿no? *Buy.3rdpl.inf. pres.bananas, right?/No?*	¿Cómo **v**amos? *How- To go. 1st pl.*	¡Vamos! *To go. 1st pl.*

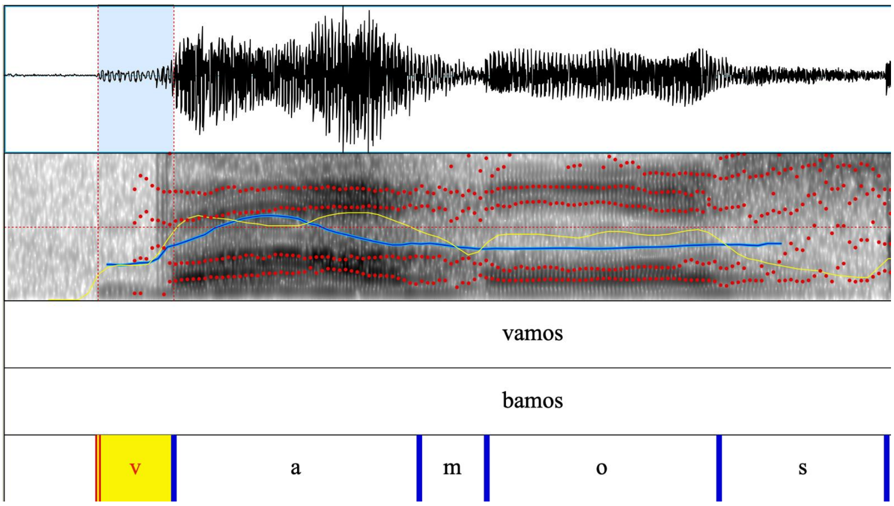
2.3. Tasks

Participants were locally recorded in a private quiet room, with a Zoom Recorder (mono) and a unidirectional microphone, as they engaged in speech production tasks. The initial task involved a ten-minute ethnic orientation interview (EOQ) adapted from Rato and Machado (2024), which was conducted in Spanish by a locally hired Research Assistant. For the monolingual MS group, the interviewer was a female bilingual Riverense, whereas for the control group, the interviewers were two female non-Montevidean Uruguayan Spanish monolinguals. Subsequently, participants engaged in two individual speech production tasks (10 min each) in front of a computer utilizing Labvanced (Finger et al. 2017), an experimental platform known for its dynamic task design and user-friendly interface; it facilitates the creation of tasks in an interactive and engaging manner, enhancing the overall participant experience. Firstly, there was a monologue (MNG) (in UP by the bilingual RS group and in MS by the monolingual MS group) in which participants were asked to tell an anecdote or a recipe; this task was intended to reconfirm their self-reported level of proficiency. Subsequently, participants engaged in a Contextualized Task, a semi-spontaneous activity in which participants were presented with written fictional scenarios to prompt naturalistic Spanish utterances featuring words with the target sounds. This had the aim of eliciting a continuous and more casual speech style, preventing the immediate influence of orthography, as observed in Trovato (2017), but avoiding the possible use of a pragmatic strategy that may result in over pronunciation of initial segments, as observed in the data of Ortega (2018), who used a narrative task. For example:

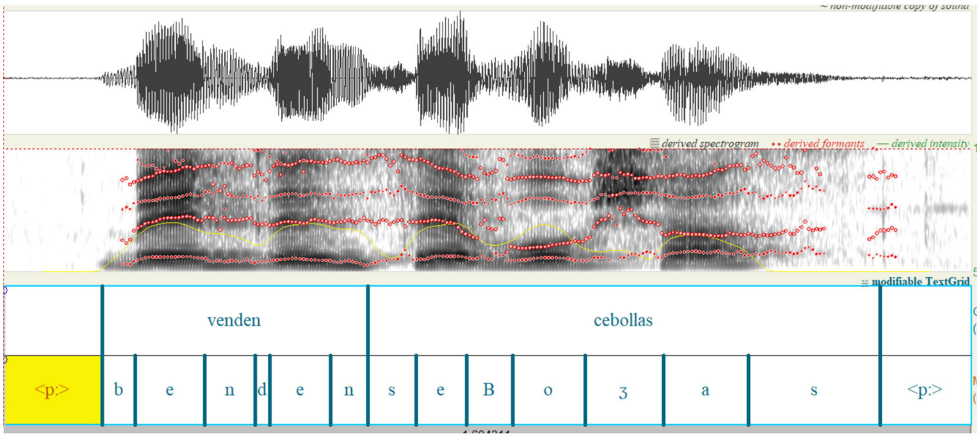
(**a**) Fictional scenario: "Entras a la tienda y preguntas si **v**enden **b**ananas" (*You walk into a store and ask if they sell bananas*)
(**b**) Expected response: "¿**V**enden **b**ananas?" (*do you sell bananas*).

2.4. Analysis

Audio recordings were initially annotated and segmented using Webmaus (Kisler et al. 2017), a web-based tool designed for the automatic phonetic segmentation and labeling of continuous speech. Employing a hybrid experimental approach that includes auditory and acoustic analyses for speech production such as in Trovato (2017), both authors meticulously reviewed and refined the TextGrids generated from this analysis in Praat (Boersma and Weenink 2023) (tier 1 for words, tier 2 for phonemes), manually adjusting boundaries when necessary, and reported the presence of [v] (labiodental fricative) (Figure 3a), [b] (full stop), and [β] (approximant) for each instance (Figure 3b).



(**a**)



(**b**)

Figure 3. (**a**) Example of segmentation of "Vamos" (We go imp.) in Praat containing [v]. (**b**) Example of segmentation of "¿Venden cebollas?" (Do you.pl. sell onions?) in Praat containing [b] and [β].

Manual boundary adjustment incorporated most of Ortega's (2018, p. 34) segmentation criteria. Below, a summary of coding criteria used in the present study is presented:

a. [b]: Sounds were coded as [b] if there was a visible burst in the spectrogram signaling the presence of a release and murmur (voicing or pre-voicing) in initial position or after a consonant (Ortega 2018, p. 34) (Figure 3b).
b. [β]: Sounds were coded as [β] if they showed continuity of formants between vowels (stable height) or post-nasally (between the nasal sound and the following vowel) (less stable). Lowering of F2 and F3 and the waveform transition served as a visual cue to identify transitions as well (Figure 3b).
c. [v]: Sounds were coded as [v] if they lacked a release in initial position and as if they exhibited a faint frication (the presence of noise in the upper region of the spectrogram, signaled by unstable higher formants) in either the initial or intervocalic positions (Figure 3a).

It is important to acknowledge that identifying and consistently measuring approximants in Praat can be a challenging task due to the lack of clear formant transitions between the consonant and the following vowel (Colantoni and Marinescu 2010) and its vowel-like nature. (Jongman et al. 2000). As explained by Trovato (2017, p. 28), fricatives have more defined spectral features due to the larger oral cavity; labiodentals, in particular, normally exhibit a flat spectrum with no dominant spectral peak and visible frication, which makes the task less difficult. To ensure consistency in segmentation and coding, TextGrids were revised in Praat by both authors in four rounds. Cases where a combination of features from more than one variant (e.g., a burst typical of a [b] stop + frication typical of a [v]) were coded based on complementary auditory evaluation.

The main acoustic measures analyzed in this study to document variation in the pronunciation of <v> and <b> were relative intensity (RI), duration, and voicing. Table 5 below summarizes the definition of each acoustic property considered in this study, the formulas and tools to perform measurements, and the anticipated trends for each variant based on the previously discussed literature.

Table 5. Table summarizing relevant information regarding the acoustic measures employed in this study.

Acoustic Measure	Definition	Measurements	Tools	Anticipated Trends
Relative intensity	Intensity difference in decibels (dB) between the consonant and the following vowel (Colantoni and Marinescu 2010)	[Mean intensity of the consonant] − [mean intensity of the vowel][1]	Praat script (Reetz 2022) to extract mean intensity and Excel to perform calculations	v > b > β
Duration	Duration in milliseconds (ms) of the analyzed segment	Total length of the interval between initial and final boundary summing up the duration of all frames within an interval	Praat script to extract duration (Reetz 2022)	v > β > b
Voicing	Presence of vibration of the vocal folds (%) during the production of a speech sound	Percentage of voicing in an interval: ([end time of frame 52] − [left edge of interval 53]) + ([number of voiced frames] x [step rate]) + ([right edge of interval 58] − [beginning time of frame 59])[2]	Praat script to extract voicing (Reetz 2022)	v > β > b

A Praat script created by Reetz (2022) was used to extract the mean intensity, duration, and voicing of the target consonants who employs a frame-based calculation system (see Pitch_Manual PDF and Pitch_notes PDF in Reetz (2022))[3].

Two analyses of the data were performed: first, a distributional analysis using logistic regression, and then an acoustic analysis with a linear mixed model and a beta regression in R (The R project for statistical computing, R Core Team (2022)). The distributional analysis was conducted based on the auditory evaluations of the production patterns of the graphemes <b> and <v> by RS and MS speakers. For the RS speakers, a multinomial regression was run as they produced three variants ([v], [b], and [β]). For the MS speakers, however, a binomial regression was employed, to account for the only two registered variants ([b] and [β]). For the acoustic analysis, the lme4 package (Bates et al. 2015) was used to apply a linear mixed-effects model (LMM) in order to determine the effects on relative intensity (RI) and duration. Given the nature of our third acoustic measure, voicing, which does not usually yield a normal distribution, we employed the GAMLSS package (Rigby and Stasinopoulos 2005) to create a Beta Regression Model (BRM) instead.

Relative intensity, percentage of voicing and duration—the acoustic dependent variables—were all treated as continuous; realizations of <v> and <b> ([v], [b] and [β]), the distributional dependent variables, were all treated as categorical. The independent variables: language variety, realization, and grapheme, were treated as categorical, and generation as continuous. For all models, the reference levels for the respective variables were the following: for Spanish variety, *MS*; for realization, [b]; for grapheme, <b>; for generation, 1.

The Distributional Models are presented in Table 6a. The Between-City Distributional Model was employed to identify differences in the distribution of [b], [β], and [v] realizations between Riverense and Montevidean speakers. The Rivera Distributional Model was used to analyze the distribution of [b], [β], and [v] realizations across different generations of RS bilingual speakers. Similarly, the Montevideo Distributional Model aimed to determine the distribution of [b] and [β] realizations within the MS data.

Table 6. (a) Multinomial and binomial models for distributional analysis. (b) Linear mixed models and beta regression models for acoustic analysis.

(a)	
Between- City Distributional Model	Realization ~ Spanish variety*grapheme
Rivera Distributional Model	Realization ~ generation*grapheme
Montevideo Distributional Model	Realization ~ generation*grapheme
(b)	
Between-City Acoustic Model	Dependent variable ~ Spanish variety*grapheme + realization + (1 ǀ participant)
Rivera Acoustic Model	Dependent variable ~ generation*grapheme + realization + (1 ǀ participant)
Montevideo Acoustic Model	Dependent variable ~ generation*grapheme + realization + (1 ǀ participant)

The acoustic models are presented in Table 6b. Like in the Distributional Models, The Between-City Acoustic Model was employed to identify differences in relative intensity and duration between MS and RS speakers. A Beta Regression Model (BRM) using the same formula was utilized to compare the percentage of voicing between the two groups, incorporating the same independent variables. The Rivera Acoustic Model was employed to trace sociolinguistic variation within RS speakers. Similarly, the Montevideo Acoustic Model analyzed MS speakers. For both models, an LMM was used to analyze the effects on relative intensity and duration, followed by a BRM with the same formula to analyze the percentage of voicing.

Both models included a random intercept for participants to accommodate individual and group-level variability, ensuring a comprehensive examination of the specified fixed effects and their interactions.

3. Results

This section provides an analysis of the distributional and acoustic results of Riverense Spanish (RS) and Montevideo Spanish (MS) pronunciation of the graphemes <v> and <b>. The presentation of results emphasizes statistically significant outcomes and pertinent descriptive statistics that enhance understanding of the findings. Each subsection begins with a comparison between both Uruguayan Spanish varieties before exploring cross-generational characteristics of MS and RS separately.

3.1. Distributional Analysis Based on Auditory Coding

3.1.1. Distributional Analysis of MS and RS Realizations

The overall distribution of/b/and/v/variants in MS and RS is presented in Table 7 below.

Table 7. Overall distribution of <b> and <v> realizations in MS and RS.

	[β]		**[b]**		**[v]**		**Total**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**
RS	547	47.03% (RS/MS)	298	25.62% (RS/MS)	318	27.34% (RS/MS)	1163	100% (Total RS)
		47.24% (Total β)		34.02% (Total b)		100% (Total v)		49.47% (Total n)
MS	610	51.35% (RS/MS)	578	48.65% (RS/MS)	0	0% (RS/MS)	1188	100% (Total MS)
		52.68% (Total β)		65.98% (Total b)		0% (Total v)		50.53% (Total n)
Total	1158	49.23% (Total *n*)	876	37.24% (Total *n*)	318	13.44% (Total *n*)	2352	100% (Total *n*)

As expected, the voiced labiodental fricative [v] is shown to be exclusively present in RS data, constituting 27.34% of all Riverense productions and being virtually absent in MS. This suggests the existence of a phonetic distinction between RS and MS, with [v] serving as a salient marker of the Riverense dialect. The presence of the approximant variant is shown to be balanced in both groups, while the full stop is substantially more produced in MS. Statistical analysis utilizing the Between-City Distributional Model (multinomial regression) confirmed the significance of these differences ($\chi^2 = 551.06$, df = 2, $p < 0.001$ ***) (Appendix B). As for the effect of grapheme, Table 8 below displays the breakdown of realizations by grapheme and language group.

Table 8. Correlation between grapheme and realization in both groups.

Riverense Spanish realizations								
Grapheme	**[b]**		**[β]**		**[v]**		**Total (Grapheme)**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**
<b>	112	28.79% (Total <b>)	274	70.44% (Total <b>)	3	0.77% (Total <b>)	389	100%
		37.58% (Total [b])		50.09% (Total [β])		0.94% (Total [v])		
<v>	186	24.03% (Total <v>)	273	35.27% (Total <b>)	315	40.7% (Total <v>)	774	100%
		62.42% (Total [b])		49.91% (Total [β])		99.06% (Total [v])		
Total (Realization)	298	100%	547	100%	318	100%	1163	

Montevideo Spanish realizations								
Grapheme	**[b]**		**[β]**		**[v]**		**Total (Grapheme)**	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**
<b>	119	29.53% (Total <b>)	284	70.47% (Total <b>)	0	0% (Total <b>	403	100%
		20.59% (Total [b])		46.56% (Total [β])		(Total [v])		
<v>	459	58.47% (Total <v>)	326	41.53% (Total <v>)	0	0% (Total <v>)	785	100%
		79.41% (Total [b])		53.44% (Total [β])		0% (Total [v])		
Total (realization)	578	100%	610	100%	0	0%	1188	

Table 8 shows that the grapheme <v> is produced as [v] in 40.7% of productions, and when RS speakers produce [v] it corresponds in 99% of occurrences to the grapheme <v>. In MS, however, [v] is non-existent and <v> is predominantly correlated with [b]. In addition to differences between the two groups, the grapheme itself is proven by the Between-City Distributional Model (multinomial regression) (Appendix B) to be an extremely significant predictor of realization in both varieties (χ^2 = 374.64, df = 2, $p < 0.001$ ***), and an interaction was found between grapheme and variety (χ^2 = 12.81, df = 2, $p < 0.01$ **).

In summary, a highly significant difference is evident between both Uruguayan Spanish varieties in their realization of <v> and <b>, primarily attributed to the presence of [v] in Riverense, an unattested variant in MS. Significant differences between groups were found globally, as well as significant differences between groups due to the effect of grapheme.

3.1.2. Distributional Analysis of Realizations in MS by Generation

This section describes the distribution of/b/allophones by all three generations of Montevideo Spanish speakers according to grapheme. In general, Montevideo Spanish conforms to what would be expected in other Spanish varieties, namely that [b] and [β] are found to correspond to both <b> and <v>, and that the variant [v] present in RS is totally absent. Additionally, there are slight generational differences in the realization of/b/allophones. The distribution of [b] and [β] by generation and grapheme is depicted in Figure 4.

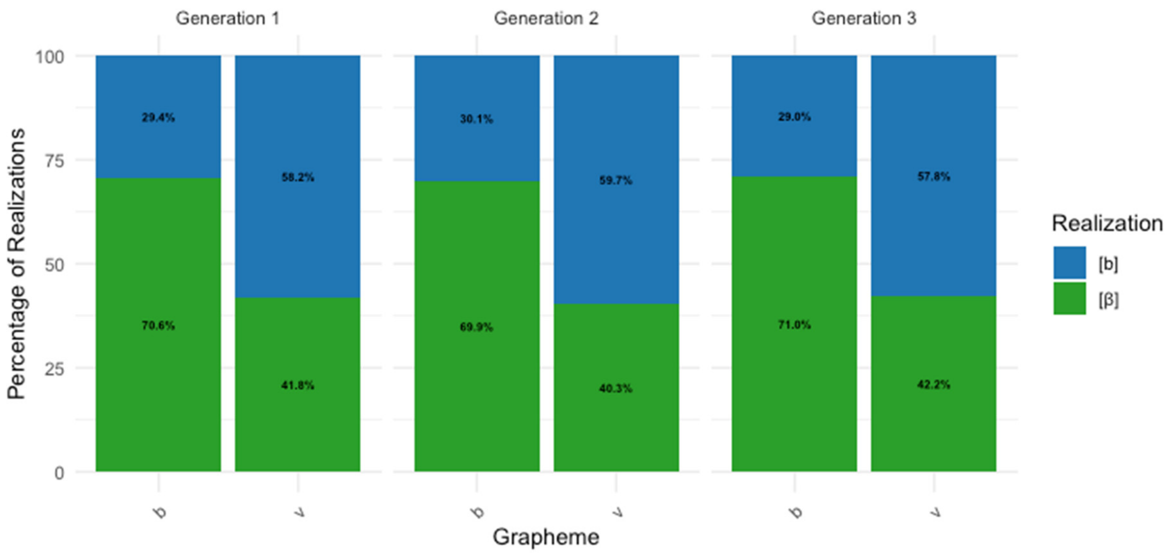


Figure 4. Barplots showing the mean productions of <v> and <b>.

As can be observed in Figure 4, all speakers produce similar rates of [β] and [b]; furthermore, an ANOVA performed on the Montevideo Distributional Model showed no effect of generation (χ^2 = 0.26, df = 2, $p > 0.05$). This indicates that spirantization of/b/is a widespread phenomenon in Montevideo Spanish, and that it is commonplace in all generations. Additionally, most [b] productions occurred with the <v> grapheme, and ANOVA results determined that the effect of grapheme was significant (χ^2 = 91.89, df = 2, $p < 0.001$ ***). However, there was no interaction between generation and grapheme (χ^2 = 0.01, df = 2, $p > 0.05$). Additionally, while the effect of grapheme is significant, the data set contains many more instances of <v> in initial and post-nasal positions, where traditionally [b] would be expected, and this likely contributes to its significance in the ANOVA. That is to say that Montevideo speakers are not more likely to produce the grapheme <v> as [b] in daily speech, and instead what is observed in the data is an effect of phonetic context.

3.1.3. Distributional Analysis of Realizations in RS by Generation

The following section describes generational variability in the production of <b> and <v> in Rivera Spanish. ANOVA results on RS Distributional Model demonstrated that generation is a highly significant factor in speakers' realizations (χ^2 = 29.29, df = 4, p > 0.001 ***), providing evidence that speakers of all three generations use different realizations. To identify further effects on Riverans' choice of /b/ realization, the data were analyzed according to grapheme within each generation. Figure 5 below shows the distribution of <b> and <v> realizations.

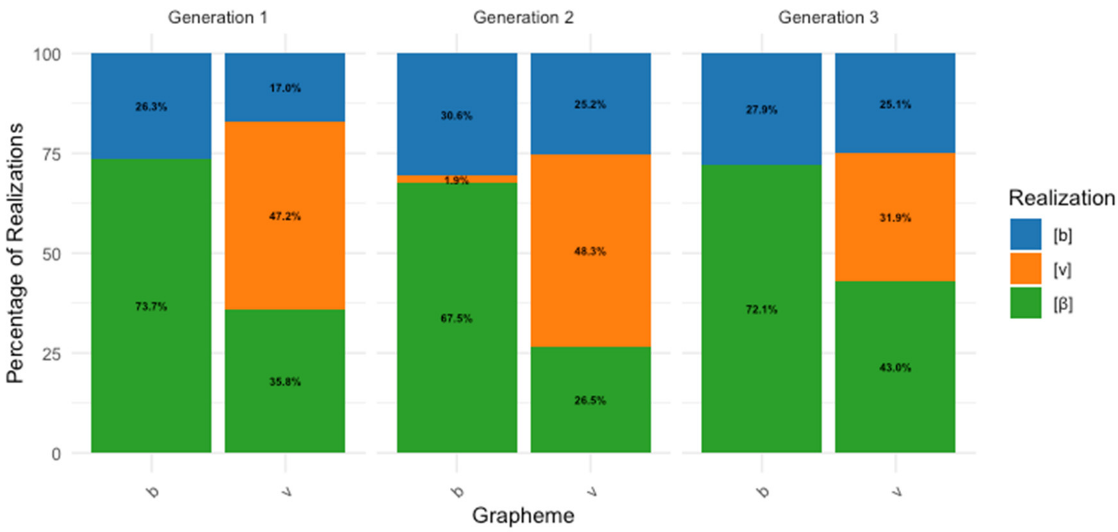


Figure 5. Barplots displaying realizations in RS by grapheme and generation.

Referring to Figure 5, the first and second generations overwhelmingly produce <v> as [v], indicating a Portuguese-like pattern with distinct/b/and/v/phonemes. The third generation, unlike the first and second, more often produces <v> as [β], though [v] does still exist as a possible realization. This suggests a generational shift towards a more Spanish-like pattern caused by the influence of MS. An ANOVA was run on the RS Distributional Model, finding that there is a highly significant effect of grapheme on speakers' realizations (χ^2 = 301.52, df = 2, p < 0.001 ***), but no interaction between generation and grapheme was found (χ^2 = 5.14, df = 4, p > 0.05). This demonstrates that, while the three generations do differ in their realizations of [b], [β], and [v] based on grapheme, the presence of [v] is still widespread among younger speakers.

The higher rates of <v> produced as [v] in the first and second generations when compared to the third generation hints towards a more Spanish-like pattern emerging among younger speakers of RS, with a preference for [β] over [v] for the <v> grapheme. However, while there is evidence of a shift towards a Spanish-like pattern, [v] is still present in the speech of younger speakers of RS, which is reflected by the ANOVA results. This indicates that, despite the shift to more Spanish-like realizations among younger speakers, the influence of Brazilian Portuguese is still prevalent in RS.

3.2. Acoustic Analysis

In this section, the results for the acoustic analysis are presented and interpreted, starting with the results between groups and followed by cross-generational individual group results.

3.2.1. Relative Intensity (RI)

Comparison of RI in MS and RS

The findings reveal that RS tends to exhibit a slightly higher mean relative intensity than MS in both graphemes (+0.63 dB for <b> and + 0.9 dB for <v>), indicating a greater overall average intensity difference with the following vowel (4.93 dB) when compared to MS (4.65 dB). This increase is supported by RS's positive estimate and t-values in the results of the Between-City Acoustic Model (LMM) (B = 1.27, se = 1.17, df = 2300.5, t = 1.08) (see Appendix B). However, the overall contrast is statistically insignificant (p = 0.02). Notably, RS speakers produce higher relative intensity values for [v], with a mean of 6.6 dB, especially in stressed syllables (5.46 dB) compared to unstressed (4.16 dB). This contributes to RS's overall higher RI average value.

As shown in Table 9, RS adheres to the anticipated RI pattern, with [v] exhibiting the greatest intensity difference, followed by [b], and finally [β], consistent with expectations. A similar pattern is observed in MS for both produced variants. Notably, among the shared realizations between both groups, RS displays a higher mean value compared to MS in the approximant [β] indicative of less lenition and lower RI in [b], indicative of less constriction. The boxplot in Figure 6 below shows the RI results for both groups by grapheme and realization.

Table 9. RI descriptive statistics per variant within groups.

	Rivera		
		Mean	**Std. deviation**
RI (dB)	β	3.64	2.82
	b	5.47	3.54
	v	6.66	3.95
	Montevideo		
		Mean	**Std. deviation**
RI (dB)	β	3.41	2.94
	b	5.95	4.29

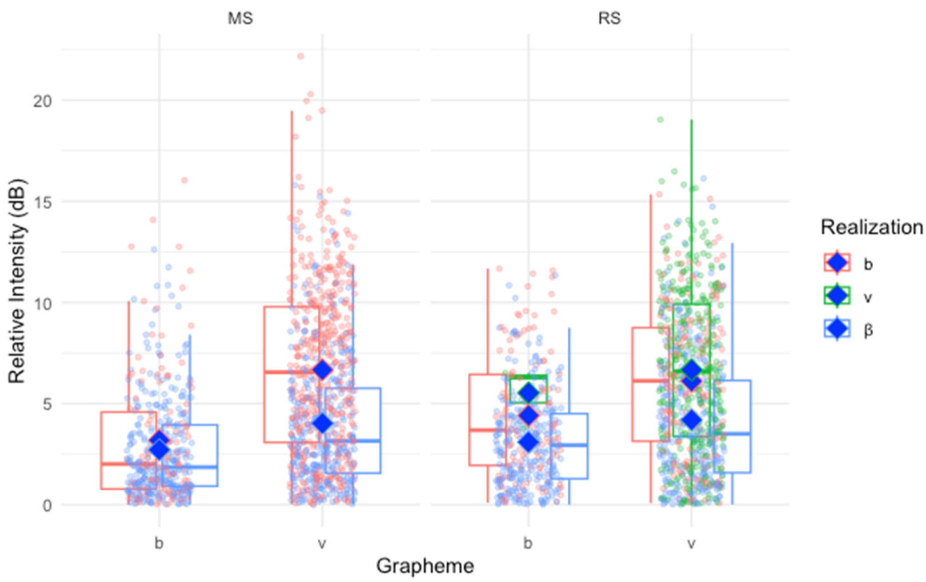


Figure 6. Boxplots displaying relative intensity by grapheme and realization in both groups.

As exposed by boxplots in Figure 6 above, Riverense RI means tend to surpass or match MS reference values. One would anticipate a higher RI in RS compared to MS due to the perceptual analysis of RS revealing Portuguese-like variants such as [b] in contexts where Spanish uses [β] (see Figures 7 and 8 below for examples), and [v] in RS, which are known to have a higher RI than the approximant [β]. Indeed, the mean RI values shown in Figure 6 demonstrate that tokens coded as [β] have the lowest RI, followed by those coded as [b] and finally by those coded by [v]. This is confirmed by the ANOVA run on the Between-City Acoustic Model, which showed a significant effect of realization on RI (χ^2 = 180.39, df = 2, p < 0.001 ***). Furthermore, for both groups, productions of the grapheme <v> had a higher RI than productions of the grapheme <b>, regardless of realization, and this also reached statistical significance (χ^2 = 129.98, df = 1, p < 0.001 ***). Finally, an interaction between group and grapheme on RI productions was found (χ^2 = 7.74, df = 1, p < 0.01 **), indicating that both factors played a role in RI. As in the distributional analysis, the differences in RI due to grapheme seen in MS are likely due to the phonetic context of the stimuli and thus reflect the distribution of the data set, as the many cases of <v> in post-nasal position produced as [b] also correlate with the higher mean RI for <v> over <b>.

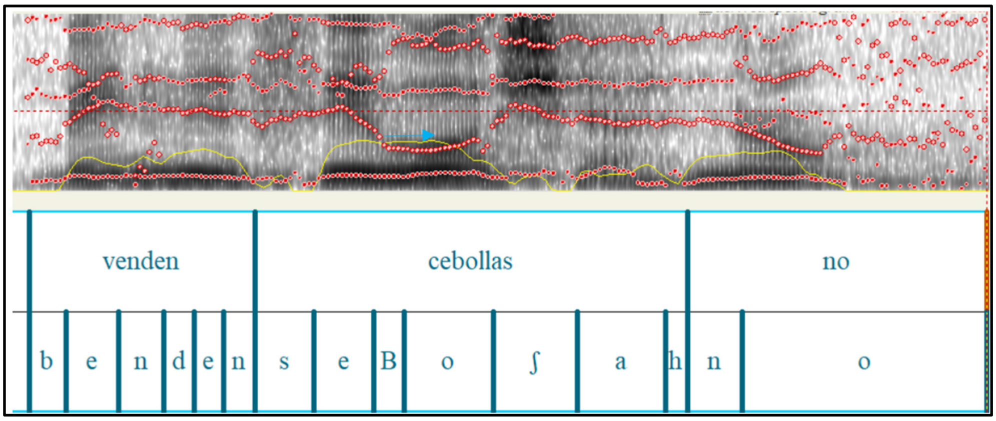


Figure 7. Spectrogram extracted from Praat showing an approximant [β] production in intervocalic position produced by an MS in tag question "venden cebollas, ¿no? (you sell onions, right?).

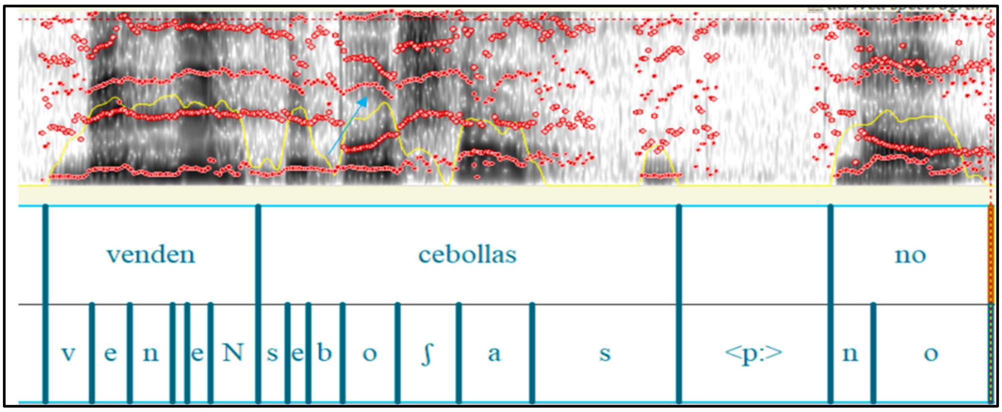
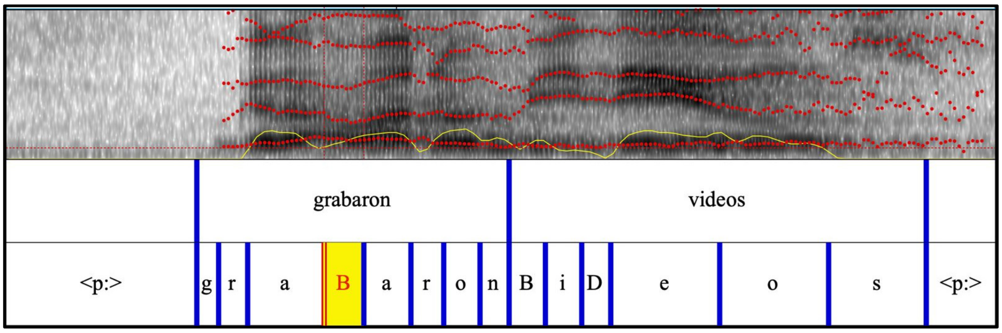


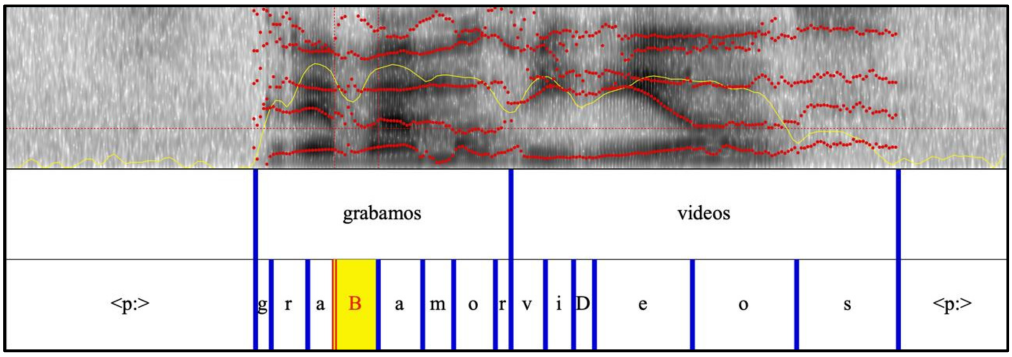
Figure 8. Example of spectrogram extracted from Praat showing full stop [b] in intervocalic position produced by an RS bilingual in tag question "venden cebollas, ¿no? (you sell onions, right?).

In addition to the high RI observed in RS, notable cases of very high RI in Montevideo were seen in older participants. These high RI values seem to be due to the participants making articulatory effort to "pronounce correctly" in certain tokens, which may explain this disparity and MS's higher SD and variability indices.

Montevideans tend to pronounce intervocalic <v> and <b> with low RI approaching 0 dB more frequently than RS speakers, as evidenced by the blue arrow in Figure 7 above. Rivera bilinguals, on the other hand, tend pronounce intervocalic <v> or <b> with a greater mean intensity difference with the vowel (approx. 1 dB of difference), which is indicative of the presence of the labiodental fricative, full stop or even less lenited approximants, as seen in Figure 9 below.



(**a**)



(**b**)

Figure 9. Intervocalic [β] produced by an MS speaker (**a**) with a more open approximant than an RS speaker (**b**) in polar question "¿Grabaron videos?" (Did you record videos?).

In summary, the results presented above show that Riverenses produce higher overall relative intensity, following the predicted trend. Substantially higher RI is found in their production of [v]. Significant differences between both Uruguayan Spanish varieties can be found where bilinguals exhibit higher values of intensity difference with the following vowel. This is representative of less lenition, possibly correlated to the realization of <v> as [v] and of <b> as a frequent [b] or a less approximantized [β], diverging from MS patterns and suggesting Portuguese influence.

Generation Comparison of RI in MS

This section compares the relative intensity of the three generations of MS speakers, considering the effects of grapheme. Boxplots in Figure 10 below show RI for each generation according to grapheme.

Figure 10 above displays RI in all three generations according to grapheme, with realization indicated by color. Boxplots demonstrate that for all three groups, RI is higher in cases where the grapheme is <v> compared to when the grapheme is <b>, and the RI for the realization [b] is higher than or equal to that of [β]. An ANOVA was performed on the Montevideo Acoustic Model to determine the effect of grapheme on RI in the Montevideo participants, as well as generational differences. The results indicated that grapheme was a highly significant factor in the RI of MS speakers ($\chi^2 = 93.07$, df = 1, $p < 0.001$ ***), with the grapheme <v> leading to significantly higher RI over <b> (B = 2.45, se = 0.37, df = 1154.96, t = 6.57, $p < 0.001$ ***). Additionally, significant differences were found between realizations ($\chi^2 = 88.36$, df = 1, $p < 0.001$ ***), showing that MS speakers produce [β] with significantly lower RI than they produce [b] (B = −1.98, se = 0.21, df = 1155.08, t = −9.4, $p < 0.001$ ***). As for generational differences, no differences between generations were identified by the model, nor was there an interaction between generation and grapheme. Finally, no interaction between generation and realization was found.

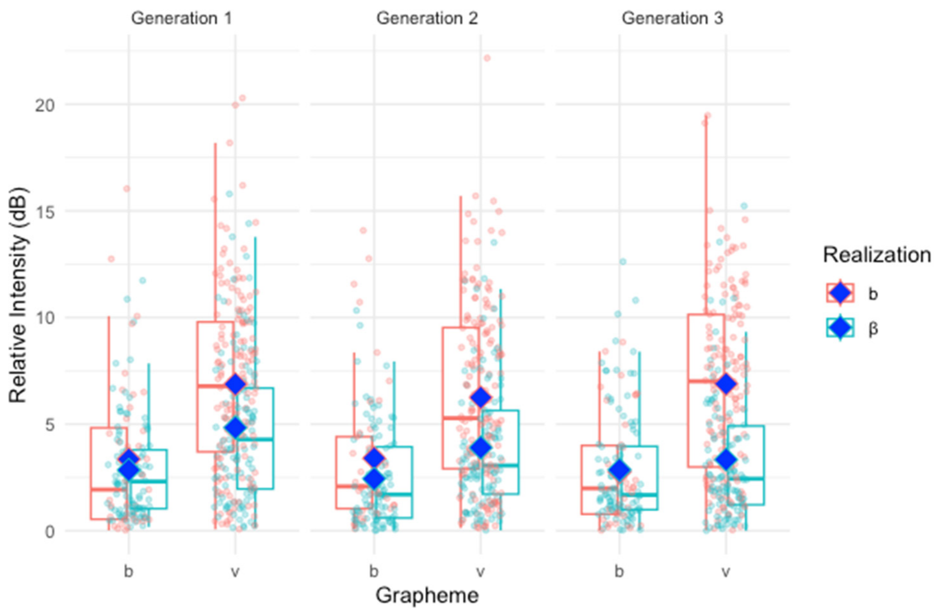


Figure 10. RI in all three generations of MS speakers, according to grapheme.

The lack of generational differences in the production of RI by MS speakers and the absence of an effect of grapheme suggest that MS is uniform and follows the expected trend for Uruguayan Spanish. The differences seen based on grapheme can likely be attributed to the distribution of the stimuli, as there are many more stimuli with <v> in the initial context and it is more likely to be produced as [b] and have a higher RI.

Generation Comparison of Relative Intensity in RS

The RI of all three generations was statistically compared by grapheme to expose generational variation in their productions of [b], [β], and [v]. Figure 11 below displays RI in each generation's productions by grapheme.

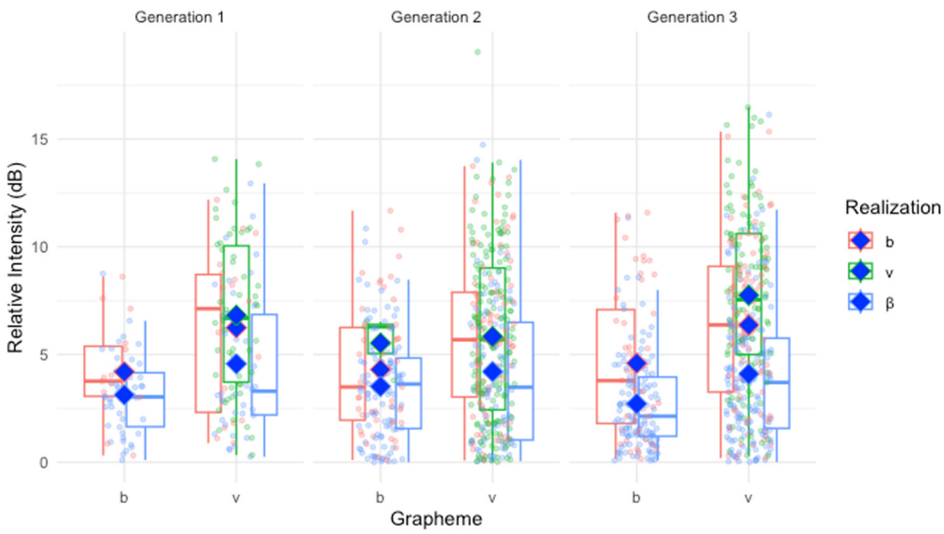


Figure 11. RI in all three generations of RS speakers according to grapheme.

According to Figure 11, all three generations produce higher RI with the grapheme <v> than <b>. As lower RI is correlated with approximantization, it is evident that all three groups are more likely to produce [β] with the grapheme <b>. However, as [v] is correlated with a higher RI than both [β] and [b], the higher RI of the <v> grapheme provides evidence of speakers producing [v] for the grapheme <v>. This is corroborated by the results of an

ANOVA run on the Rivera Acoustic Model, which showed an effect of grapheme on RS speakers' RI (χ^2 = 97.23, df = 2, $p < 0.001$ ***), with the model's results indicating that RS speakers produce <v> with a higher RI than they do <b> (B = 1.52, se = 0.53, df = 1142.28, t = 2.85, $p < 0.01$ **).

Additionally, there was a significant interaction between generation and grapheme (χ^2 = 8.72, df = 2, $p < 0.05$ *), showing that, while there was no effect of generation itself, the different generations do differ in their productions based on grapheme. Indeed, as shown in Figure 11, the third generation produces higher RI than the first and second generations with the <v> grapheme, suggesting that this generation is often producing a Portuguese-like [v] for <v> instead of the expected Spanish [b~β]. This result shows a lack of generational variation when it comes to RI; however, this correlates well with the results of the distributional analysis, which also showed no generational differences for the realization of graphemes <v> and <b>, indicating that [v] is a pervasive feature of Rivera Spanish.

3.2.2. Duration

Comparison of MS and RS in the Duration of <b> and <v>

The results presented in Table 10 below show the mean durations and standard deviations of/b/realizations in both MS and RS.

Table 10. Duration descriptive statistics per variant within groups.

		Rivera	
		Mean	**Std. deviation**
Duration (ms)	β	53.12	21.99
	b	54.65	28.01
	v	68.33	36.2
		Montevideo	
		Mean	**Std. deviation**
Duration (ms)	β	49.25	23.6
	b	57.2	33.62

The ANOVA of the outcome of the Between-City Acoustic Model confirms that both groups produce all different realizations with significantly differing durations (χ^2 = 50.6, df = 2, $p < 0.001$ ***). Furthermore, the results of the Between-City Acoustic Model reveal that both RS and MS speakers produce [β] shorter longer than they do [b] (B = −5.99, se = 1.28, df = 2303.63, t = −4.7, $p < 0.001$ ***) and the Rivera speakers produce [v] longer than they do [b] or [β] (B = 8.06, se = 2.32, df = 2243.13, t = 3.48, $p < 0.001$ ***).

As for the effects of grapheme, the durations for both groups are plotted by grapheme below in Figure 12.

As shown in Figure 12, RS speakers tend to produce <v> longer than they do <b>, while MS speakers appear to produce both graphemes with a similar duration, except in the case where <v> is produced as [β]. However, the ANOVA run on the Between-City Acoustic Model indicated not only that grapheme had a significant effect on durations (χ^2 = 7.91, df = 1, $p < 0.01$ **), but that there was an interaction between grapheme and language group (χ^2 = 8.69, df = 1, $p < 0.01$ **). The results of the model showed that, in both groups, the grapheme <v> was produced with a significantly shorter duration (B = −6.96, se = 1.72, df = 2290.51, t = −4.06, $p < 0.001$ ***), though Riverans produced <v> with a significantly longer duration (B = 7.52, se = 2.55, df = 2322.21, t = 2.95, $p < 0.01$ **). The longer durations seen for <v> in RS is indicative of Riverans' [v] productions, which have a longer duration than [b] or [β]. This contrasts with the overall shorter duration of <v>, which is likely due to the [b] and [β] productions of MS speakers when producing <v> in utterance-initial or intervocalic positions.

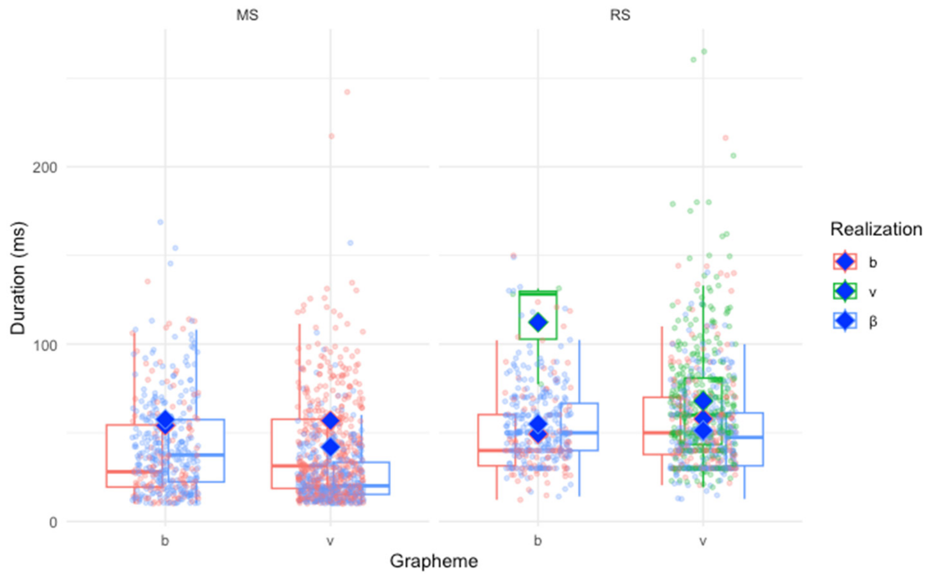


Figure 12. Boxplots showing the distribution of durations for MS and RS by grapheme.

In summary, Riverense speakers tend to pronounce <v> and <b> with an overall longer duration than MS speakers, primarily due to the production [v] in the case of <v>, which as displayed above in Figure 12 tends to exhibit extended duration. Finally, notably longer [β] can be seen in RS, suggesting that Riverenses exhibit less lenition.

Generational Comparison of Duration within MS

The following section examines generational differences in duration of <b> and <v> produced by MS speakers according to grapheme and realization. The durations for each generation by grapheme are displayed below in Figure 13.

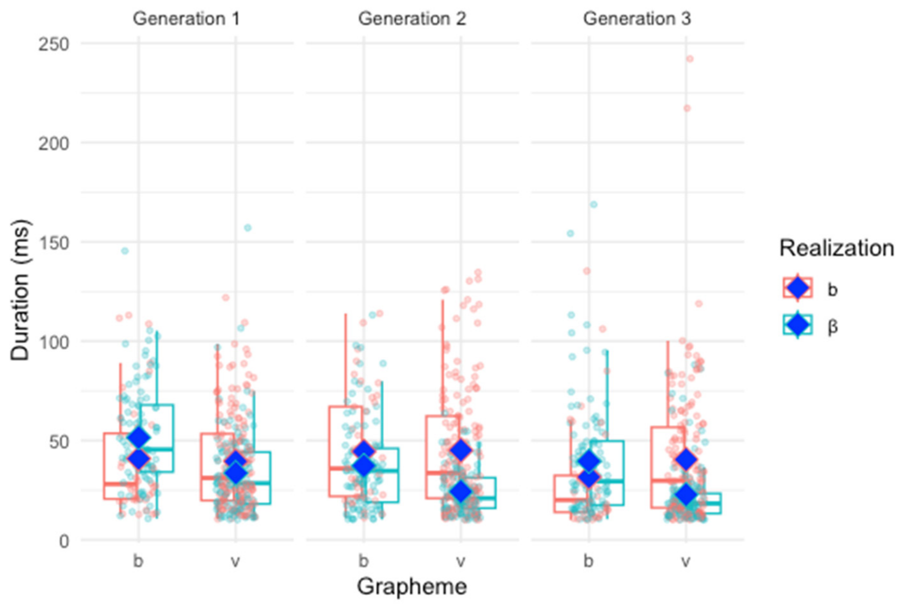


Figure 13. Boxplots showing duration by grapheme for each generation of MS speakers, with realization indicated by color.

As shown in Figure 13, the durations of/b/allophones by MS speakers display a great deal of variability, with the first generation producing <b> longer than <v>. The second generation follows a similar pattern with <b> and <v>, though their productions coded as [b] are longer than those coded as [β], while the first generation's [β] is produced longer with the grapheme <b>. Finally, the third generation exhibits the shortest durations of all generations, with the <v> productions coded as [b] being longer than <v> productions coded as [β]. At the same time, the first generation's <b> productions coded as [β] are on average longer than those coded as [b]. ANOVA showed an effect of realization ($\chi^2 = 35.58$, df = 1, $p < 0.001$ ***), with the results of the model indicating that MS speakers produce [β] significantly shorter than they do [b] (B = −9.25 se = 1.56, df = 1153.53, t = −5.96 $p < 0.001$ ***).

As for the effect of grapheme, the results of the ANOVA run on the Montevideo Acoustic Model determined grapheme to be a significant factor in the durations of all generations of MS speakers ($\chi^2 = 27.59$, df = 1, $p < 0.001$ ***), with the results of the model showing that <v> is produced shorter than <b> for all generations (B = −14.3 se = 2.75, df = 1153.44, t = −5.21 $p < 0.001$ ***). In addition to this, the ANOVA showed an interaction between grapheme and generation ($\chi^2 = 6.89$, df = 2, $p < 0.05$ *), despite the absence of an effect of generation. These results indicate that speakers of MS lenite more in cases where the grapheme is <b>, likely due to its frequent appearance intervocalically in the data set. The lack of an effect of generation indicates that, despite the slight observed differences in generation, there is very little generational variation in MS in terms of duration.

Generational Comparison of Duration in RS

The following section analyzes duration as a correlate of lenition in Rivera Spanish by comparing the three generations in terms of the duration of their productions of <b> and <v>. The durations of Rivera <b> and <v> by generation are displayed below in Figure 14.

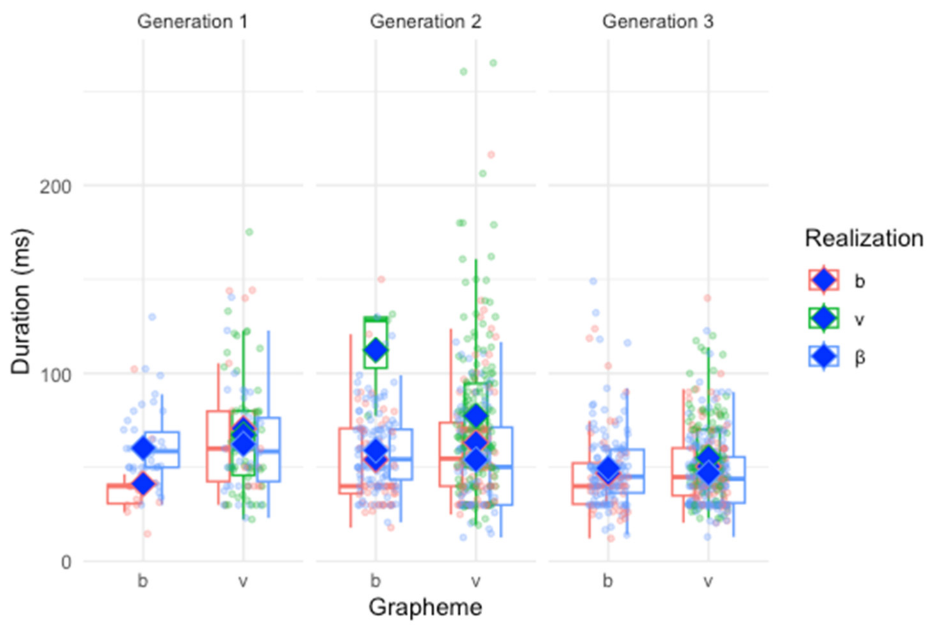


Figure 14. Boxplots showing duration by grapheme for each generation of RS speakers, with realization indicated by color.

Figure 14 provides further evidence of [v] in RS, as it exposes the fact that productions of the <v> grapheme are considerably longer than those for the <b> grapheme. Furthermore, older generations consistently show longer durations for both the <v> and <b> graphemes compared to the third generation, providing evidence for a generational continuum. This is also suggested by the significance of generation as an effect on duration in the results of the ANOVA run on the Rivera Acoustic Model ($\chi^2 = 15.4$, df = 2, $p < 0.001$ ***), which is evidence of a distinction between <v> and <b> for the second and third generations that is not as prominent in the first generation. Despite these differences, the ANOVA results did not show a significant effect of grapheme, nor an interaction between generation and grapheme. This again is due to the strong influence of Brazilian Portuguese on Rivera Spanish affecting all generations.

It is also evident that [v] is produced with much longer durations than [b] and [β]. Indeed, the ANOVA indicated that realization was a significant factor in the duration of <v> and <b> by RS speakers ($\chi^2 = 26.36$, df = 2, $p < 0.001$ ***). In addition to this, the results of the model confirm that [v] is produced significantly longer than [b] (B = 11.05 se = 2.42, df = 1107.33, t = 4.58 $p < 0.001$ ***).

In conclusion, in RS we see longer durations for the <v> grapheme produced by older speakers than younger speakers. This is evidence of a /b/-/v/distinction present in the phonological system of older speakers, which is not as prominent in younger speakers as they attempt to conform to monolingual trends.

3.2.3. Voicing

Comparison of Voicing of <v> and <b> in MS and RS

Table 11 below summarizes descriptive statistics for percentage of voicing by RS and MS by realization.

Table 11. Percentage of voicing in RS and MS for realizations of <v> and <b>.

	Rivera		
		Mean	**Std. deviation**
Voicing (%)	β	97.6	11
	b	89.9	19.8
	v	91.9	16.3
	Montevideo		
		Mean	**Std. deviation**
Voicing (%)	β	96.7	15
	b	81.6	26.6

Results in Table 11 above suggest that in Rivera there is a stronger and more consistent tendency to voice [b] when compared to Montevideo, which displays more variability, as indicated by the standard deviation. However, this difference was found not to be significant by the Between-City BRM, though it did confirm that both [v] and [β] are produced with significantly more voicing (Appendix B). The degree of voicing for both groups is shown by grapheme below in Figure 15.

The statistical analysis did not reveal any significant differences between speaker groups, possibly due to high intragroup variability or low sensitivity of the model. Yet, the boxplots displayed by Figure 15 above expose a substantial difference in voicing between Riverense and Montevidean based on realizations. Notably, both groups exhibit high variability in the percentage of voicing where occlusive [b] was perceived during the auditory analysis. However, RS shows approximately 8% higher voicing compared to MS and achieves considerably higher fence values. This could possibly correspond to the previously observed presence of [v] for grapheme <v> in Section 3.1.1, which tends to display higher voicing than [b].

Although Between-City BRM results did not prove this difference to be significant, this outcome was anticipated due to the previously described non-target presence of utterance initial approximant [β] by Riverenses, as exemplified in Figure 16a. Furthermore, in instances where <v> appeared at the beginning of utterances, such as in "¡Vamos!" (*Let's go!*), Riverenses often exhibited pre-voicing, resulting in (a) what could be described as an initial [ᵐb͡v] pattern due to a stop closure and frication (Figure 16b) or (b) in other cases, a very open initial labiodental that could be signaling the presence of what could be described as an approximant [v] due to the absence of high-frequency frication but presence of vowel-like formants (Figure 16c).

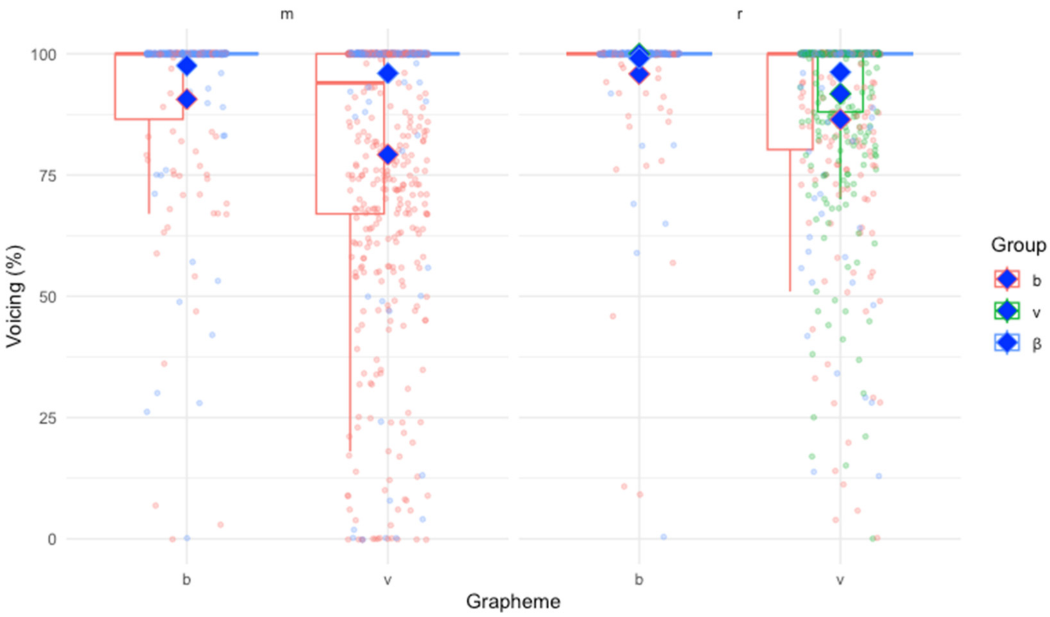
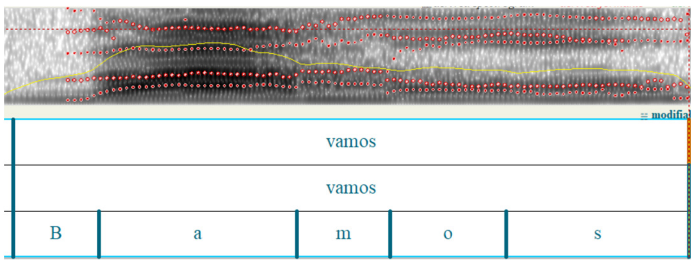
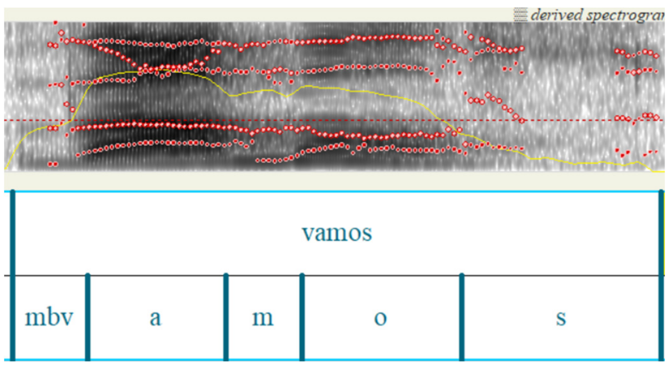


Figure 15. Degree of voicing in MS and RS by grapheme, with realizations indicated by color.

In summary, the analysis of voicing patterns in Uruguayan Spanish revealed that Riverense Spanish exhibits a higher overall percentage of voicing for the graphemes <v> and <b> and this phenomenon can largely be attributed to the production of the Portuguese-like variant [v] in the presence of grapheme <v>.

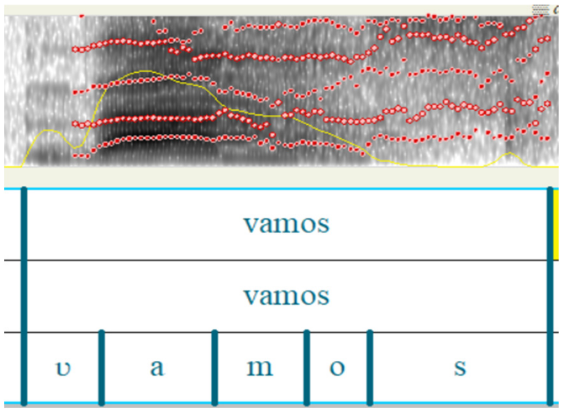


(**a**)



(**b**)

Figure 16. *Cont.*



(**c**)

Figure 16. Example of initial <v> produced by Riverenses as approximant [β] (**a**) and as affricate [$^{\text{m}}$b͡v] (**b**) and as an approximant [ʋ] (**c**) for the mandate "¡Vamos!" (let's go!).

Generational Comparison of Voicing in MS

In this section, the percentage of voicing of <b> and <v> will be described based on grapheme, as is displayed in Figure 17 below.

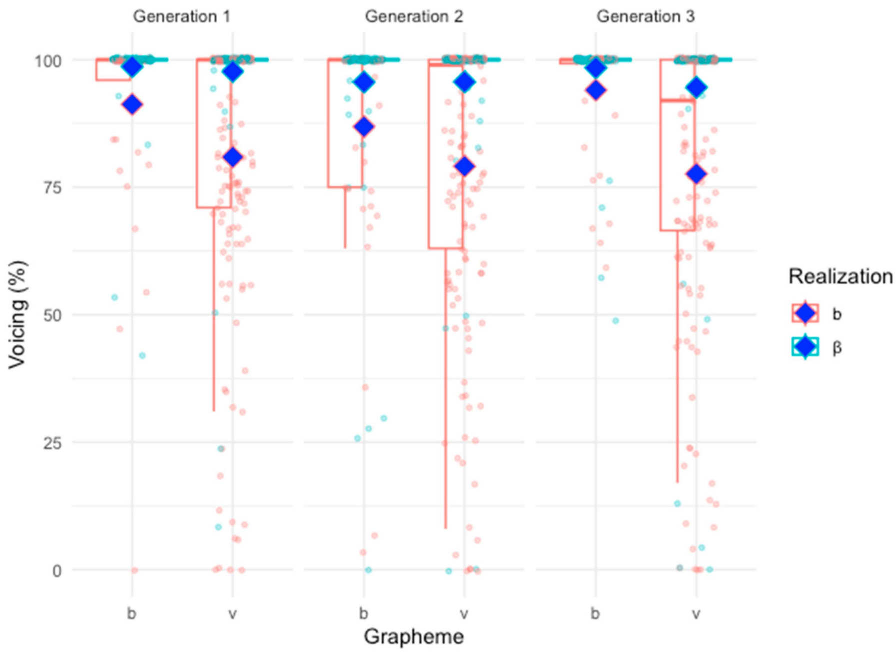


Figure 17. Voicing by grapheme for all three generations of MS speakers.

As displayed by Figure 17, Montevideo Spanish speakers tend to produce/b/with a lower percentage of voicing and this is true for all three generations. The Montevideo BRM determined that MS speakers produce [β] significantly more voiced than [b] (B = 0.49, se = 0.07, t = 7.22, $p < 0.001$ ***); however, no other significant effects on voicing in MS were found. This means that, while results report that <b> is correlated with a higher percentage of voicing across generations, this was not confirmed by the Montevideo BRM. The model shows that <b> and <v> do not differ in their percentage of voicing and nor is there an interaction between generation and grapheme. This result indicates that MS speakers of all generations produce the graphemes <b> and <v> with the same amount of voicing and thus the same degree of approximantization.

Generational Comparison of <b> and <v> in RS

Regarding how voicing is realized in productions of <b> and <v> in RS, the degree of voicing was analyzed in all three generations according to grapheme. These results are shown in Figure 18.

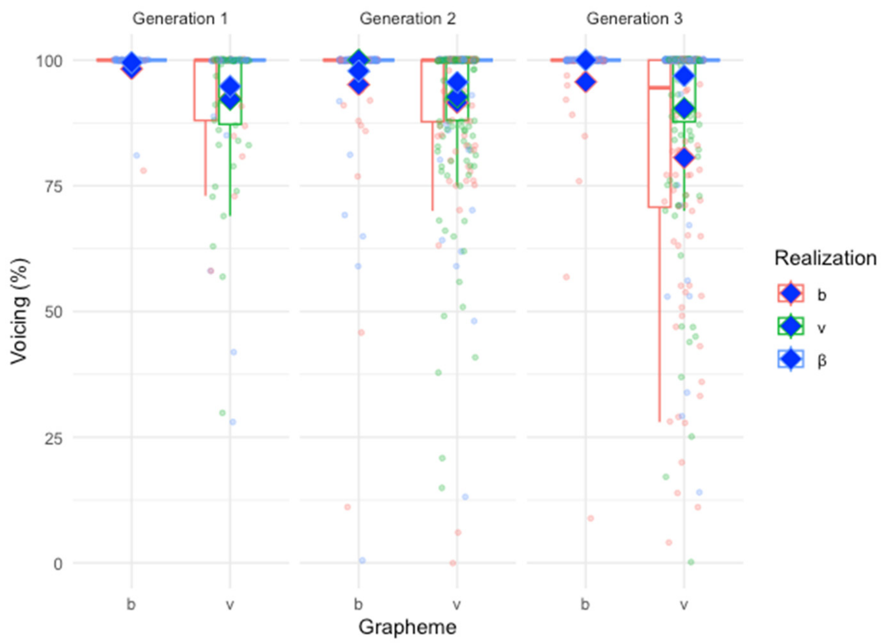


Figure 18. Degree of voicing in RS in all three generations by grapheme, with realizations indicated by color.

As depicted in Figure 18, all generations produce <b> with more voicing than they produce <v>, indicating a higher degree of approximantization. Additionally, the first generation produces <v> with more voicing than the second generation, and the second generation produces <v> with more voicing than the third generation. As voicing is correlated with fricativization, this provides evidence that the first generation produces <v> with a more fricative-like [v] than the more stop- or approximant-like [b] or [β] produced by the third generation. Further evidence for this is provided by productions coded as [v] generally having a higher percentage of voicing than those coded as [b]. Despite all this, the Rivera BRM determined that differences in voicing due to grapheme and generation are not significant and no interaction between generation and grapheme was found. In addition, the model indicated that while [β] was produced with significantly more voicing than [b], [v] was not. Once more, we see a more Portuguese-like pattern in the older generations when compared to the younger generation, though the lack of significance points to the strong influence of Brazilian Portuguese in RS.

4. Discussion

The current paper examines <v> and <b> production in three generations of speakers from two Uruguayan Spanish varieties: Monolingual Montevideo Spanish (the national standard) and Riverense Spanish, spoken by Spanish–Portuguese bilinguals in Rivera City in the Uruguay–Brazilian border.

Our study builds upon and adds to previous research, particularly studies like those of Waltermire and Gradoville (2020), and Gradoville et al. (2021), which have documented the presence of Portuguese-like realizations of consonants such as <v> and <b> in Riverense Spanish. More precisely, unlike these previous studies that primarily relied on qualitative or perceptual assessments, we intended to take a more precise analytical approach by performing not only a distributional analysis based on auditory coding, but also an acoustic–phonetic one. To achieve this, we measured relative intensity, duration, and voicing, which are known for their effectiveness in capturing variation in stops and fricatives. With this, we hoped to provide more objective insights into the acoustic properties of [v], [β], and [b] in Riverense Spanish.

At the same time, this paper also aimed to provide a comparative analysis of RS with a well-defined baseline—Montevideo Spanish—as there is a lack of clear references regarding these phenomena in this variety. Through this comparative analysis, we sought to identify differences and similarities between the two varieties, contributing to a deeper understanding of the phonological system of standard and regional Uruguayan Spanish.

Finally, our objective was also to analyze cross-generational variation of <v> and <b> pronunciation in both varieties, considering these studies have shown that older speakers favor Portuguese-like labiodental [v] while younger speakers produce more approximantized [β]—typical of Spanish—as an identity marker. Employing this methodology, we aimed to gain better understanding of how pronunciation patterns evolve in Riverense Spanish.

The discussion below systematically analyzes the findings corresponding to each research question addressed in the study.

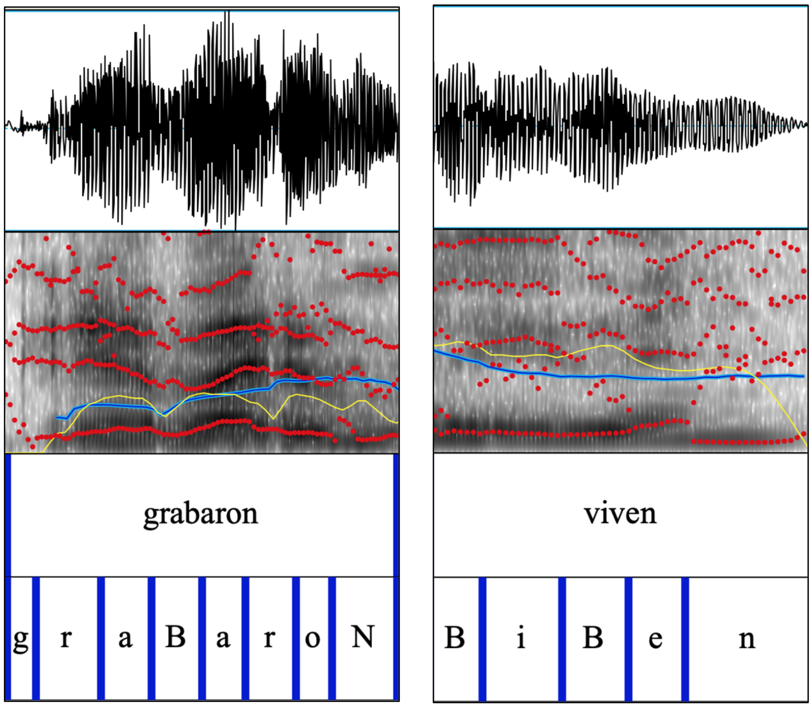
4.1. RQ1. Are There Measurable Differences between the Production of <v> and <b> of Rivera Spanish and Montevideo Spanish? What Acoustic Measures Better Portray These Differences?

We hypothesized that bilinguals from Rivera would diverge from monolingual Montevideo Spanish speakers by exhibiting Portuguese-like variants in their pronunciation of <v> and <b>. This expectation was based on anticipated differences in relative intensity, duration, and voicing patterns between the two groups that were expected to support auditory coding and reveal the acoustic nature behind the distinctive patterns.

When comparing productions of <b> and <v> graphemes between MS and RS in the distributional analysis, a highly significant difference becomes apparent between these two varieties of Uruguayan Spanish. Notably, this is due to the frequent presence of labiodental [v] in Riverense, a variant not observed in MS. This aligns with our expectations, given that in standard Spanish varieties like Montevideo Spanish, words written with ⟨v⟩ typically correspond to a bilabial obstruent phoneme/b/, whereas Portuguese distinguishes between a bilabial obstruent phoneme/b/and a labiodental fricative phoneme/v/. Gradoville et al. (2024) found that [v] is present among Montevideans as a pedantic variant, surfacing primarily as a hypercorrection during reading. The absence of [v] in the spontaneous speech of Montevideans in our study confirms that this contrast is not produced in natural, everyday communication.

While both Uruguayan Spanish varieties were found not to substantially differ based on grapheme in the perceptual analysis, interesting observations surfaced concerning phonetic context. In particular, RS frequently exhibits non-target variants in specific contexts. For instance, a full stop [b] is seen in post-rhotic position aligning with Portuguese (e.g., [ˈʃeɾ.ba] instead of [ˈʃeɾ.βa]), and a [β] approximant in post-nasal positions, possibly due to the influence of the voiced environment in sequences like N + ⟨b⟩/⟨v⟩ + V (e.g., [emˈβol.βe.mos], instead of [enˈbol.βe.mos]), and an unexpected [β] approximant in utterance initial position (e.g., [ˈβje.nen] instead of [ˈbje.nen]). Although the low proportion of some of the first two described non-target variants prevents us from asserting their significance, these findings highlight the complexity of RS's phonological system, which notably diverges from the Montevidean patterns that are representative of standard Spanish <b> and <v> production, suggesting a strong influence of Portuguese.

In general, the acoustic measures substantiate and expand upon the distributional findings from auditory coding. Riverenses higher overall relative intensity aligns with the significantly observed presence of labiodental fricative [v] in their speech. Substantially higher RI is found in their production of [v] when compared to the other two attested variants, following the expected intensity trend predicted in Table 5, which shows RI increases with frication. Significant differences between both Uruguayan Spanish varieties can be observed, in which bilinguals exhibit higher intensity differences with the following vowel. This suggests less lenition and more constriction, potentially correlated with the previously observed frequent realization of <v> as [v] and, to a lesser extent, of <b> as either [b] or a less approximantized [β], which can be found in several cases (Figure 19).



(**a**) (**b**)

Figure 19. Constricted Montevideo approximant (**a**) and less constricted Rivera approximant (**b**). The red dotted lines, yellow line and blue lines indicate formants (Hz), intensity (dB) and pitch (Hz), respectively.

At the same time, Riverense speakers tend to pronounce <v> and <b> with an overall longer duration, primarily due to the production of fricative [v] in the case of <v>, a variant that is expected to always display extended duration when compared to the rest (Table 5).

Finally, the analysis of voicing patterns in Uruguayan Spanish revealed that Riverense Spanish exhibits a higher overall percentage of voicing for the graphemes <v> and <b> than Montevidean Spanish. This phenomenon observed in Riverense can largely be attributed to the production of the Portuguese-like variant [v] in the presence of grapheme <v>, which, in terms of voicing, is expected to attain higher values (Table 5).

An observed presence of prevoicing in initial position during auditory coding correlates with some of the non-target patterns described in the results such as initial approximant [β]. However, a combination of voicing, duration, RI, and spectrographic features support the possible presence of innovative patterns that are neither fully Spanish- nor Portuguese-like in initial position. This takes the form of an affricate [ᵐb͡v], which could normally occur in intermediate post-nasal position or a possible approximant [ʋ], which has been attested in other varieties like Chilean Spanish (Sadowsky 2010; Rogers 2016). We argue that the characteristics of these two variants portray a combination of distinctive features from both varieties, representing what could be described as novel hybrid patterns. We therefore believe the latter pattern would fall between [β] and [v], and the former between [b] and [ʋ] on the continuum proposed by Gradoville et al. (2024) based on degree of constriction for the prototypical/v/and/b/variants in border-Uruguayan Spanish (Figure 20).

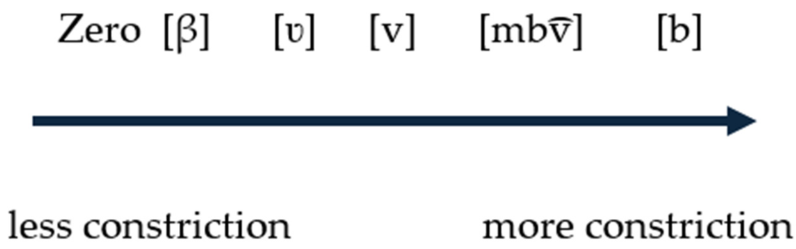


Figure 20. Adaptation of Figure 1 in Gradoville et al. (2024, p. 7) representing location of variants of/b/and/v/on the scale of degree of constriction.

4.2. RQ2. Can We Trace Cross-Generational Differences within RS? Which Measures Portray These Differences Better?

We hypothesized that older generations would diverge more from the expected standard Spanish target realizations and corresponding acoustic values due to the stronger influence of Portuguese in their speech and a stronger local identity. Our prediction was based on findings from previous studies such as those of Carvalho (2004, 2006), Waltermire (2010), and Waltermire and Gradoville (2020), which showed that older Riverenses exhibit more Portuguese-like patterns in their speech, while younger generations tend to exhibit more Montevideo-like patterns that are used as prestige markers. Assuming Montevideo Spanish would reproduce Spanish standard realizations and acoustic values, we expected Riverenses from different age groups to diverge from Montevidean Spanish baseline to different extents.

In Montevideo, the generational distributional analysis reveals consistent patterns across the three generations regarding the realization of <b> and <v>. All generations consistently produce [b] and [β] as expected, regardless of grapheme, which is compatible with standard Spanish patterns. In Riverense Spanish, however, the generational distributional analysis highlights a phonemic/v/distinct from [b~β]. As expected, auditory coding suggests that older participants produce higher labiodentalization of <v> than younger generations (generations 2 and 3), who also frequently produce it. More specifically, ANOVA results from the Rivera Spanish Distributional Model demonstrate a continuum from a more Portuguese-like system to a more Spanish-like system, establishing generation as a highly predictive factor in speakers' phonemic realizations. The first and second generations often produce [v] with the grapheme <v>, as in Portuguese phonology, while the third generation shifts towards Spanish-like realizations, frequently producing <v> as [β].

Acoustic results support these findings and reveal new interesting results. In Montevideo, there is low variation between generations in terms of RI. In contrast, Riverense Spanish exhibits clear cross-generational variation. More specifically, the youngest speakers produce <v> and <b> with less constriction (closer to 0 dB RI) than older speakers, which aligns with the previously observed distributional trend. While older speakers are producing higher RI due to a high presence of [v] in their speech, younger speakers are producing lower RI signaling a lower presence of [v] and a higher presence of [β]. This is also evidenced by the longer durations and higher percentage of voicing in the productions of older speakers, suggesting the existence of [v] where younger speakers opt for [b] or [β]. Based on this, we argue that the fact that younger speakers in both Uruguayan Spanish varieties (MS and RS) are leniting more than older ones may be evidence of the previously described regional stop-weakening phenomenon, in that is used by younger speakers as an identity marker to sound more Montevideo-like (Waltermire 2008, 2010; Waltermire and Gradoville 2020). Further and deeper analysis is needed to reconfirm whether these values, which suggest higher approximantization in younger Riverenses, correspond to [β] and/or other possible variants like [ʋ], for which we found evidence.

5. Conclusions

In line with predictions, the evidence presented herein regarding the pronunciation of <v> and <b> in Uruguayan Spanish indicates significant differences between Riverense Spanish and Montevideo Spanish [v] and [b] production, at both the distributional and acoustic levels. Results from both types of analyses suggest that this difference is primarily due to the presence of [v] in Riverense Spanish—a variant characteristic of Portuguese and absent in Montevideo Spanish, at least in spontaneous speech style—as it has been attested in Montevidean read-speech as a pedantic v (Gradoville et al. 2024). This contrast between RS and MS was further supported by Riverenses' overall higher values of relative intensity, duration, and voicing, proving differences are effectively measurable, which confirms our Hypothesis 1 to be true. It is important to mention that differences between both Uruguayan Spanish groups were not only observed at the systematic level, but also evident at the frequency one. The low but still present production of Portuguese-like stop [b] patterns, was also supported by acoustic measures and adds to the aforementioned existing body of work that has attested cross-linguistic influence of Portuguese phonology into border-Uruguayan Spanish.

The observation of variants that exhibit characteristics from both Spanish and Portuguese, yet are not compatible with either monolingual standard form, reflects innovation and the dynamicity of bilingual speech. Further analysis is needed, however, to confirm whether they represent a change in progress or not. Regardless, this highlights the complexity of borderland linguistic systems like that of Rivera, a shared linguistic space where languages have been historically in contact and in daily interaction.

An analysis of patterns based on generation further adds to observations above. In particular, while Montevideans do not exhibit substantial variation confirming the stability of its phonological system, Riverenses from different age groups show clear distinctive behavior, contributing to high levels of variation. Specifically, clear cross-generational continuums can be traced, confirming our predictions of Hypothesis 2 and aligning with previous findings in studies like (i.e., Waltermire 2008, 2010; Gradoville et al. 2021; Machado 2024) in that older speakers exhibit more Portuguese-like patterns (i.e., more frequency of [v]; higher acoustic values that signal higher fricativization) and younger speakers produce more Spanish-like patterns (i.e., more overall [β] approximants; acoustic values that signal more lenition).

The fact that [v] was present in all generations of Riverense Spanish bilinguals coexisting with the Spanish forms indicates a community grammar (Carvalho 2014) with shared linguistic choices and societal norms. However, the fact that [v] frequency decreases as generations increase from older to younger may be a sign of loss of this distinctive feature and/or a change in progress. The possibility of a generation-motivated movement of divergence from Portuguese and convergence towards Spanish in [b] − [v] production motivates further exploration of the effect and interaction of other relevant social, demographic and sociolinguistic variables that have been shown to determine speech variation in Riverense Spanish like identity, language use and preference, gender, socioeconomic background, and place of residence, among others (Machado 2024). Based on this, our next step is to conduct a multivariate analysis to better understand the reasons behind the observed generational trends that may be obscuring deeper motivations. We believe, also, that by incorporating interactional/mediated tasks (e.g., conversational, repetition with MS speakers vs. RS speakers) into our methodology, we could explore Riverenses' tendencies of speech accommodation, possibly contributing to show their ability to keep both language systems separate (Carvalho 2014).

With this descriptive and comparative study, we hope to contribute to the deeper knowledge not only of the phonetics and phonology of border-Uruguayan Spanish but also of Montevideo Spanish, an underexplored variety of Spanish. We believe our findings expose cross-linguistic influence in a border setting with rigorous analytical methods that go beyond a basic analysis based on perceptual identification, offering more reliable results. Our study suggests that duration, relative intensity, and voicing are reliable indicators for variations of <v> and <b> in the studied speaker groups. We hope our findings motivate future studies that continue to look at the linguistic dynamics within this bilingual community but also numerous others residing in borderlands, where linguistic stigmatization and identity feelings exert significant influence.

6. Limitations of the Study

In reflecting on the findings of our study, it is important to acknowledge several limitations that may have influenced the scope and interpretation of our results. Firstly, it is important to mention that our study stems from a larger project on Uruguayan Spanish prosody. The stimuli were tailored specifically for the purposes of analyzing intonational, rhythmic and speech variation in Riverense and Montevidean Spanish; hence, it was not designed to observe the currently studied phonological phenomena. This explains why our stimuli were not even, resulting in data imbalance. It is due to this imbalance that a more detailed analysis which considered phonetic context, following segment and stress as variables was not possible.

In addition, while data from the semi-spontaneous task led to significant findings on pronunciation patterns of <v> and <b> in Uruguayan Spanish, incorporating a broader range of task styles—from fully spontaneous to fully controlled tasks—could have enriched our understanding of the dynamics behind the observed patterns. As previously mentioned, including tasks such as repetition tasks or conversational speech could allow us to measure accommodation patterns and better understand how linguistic attitudes, preferences, and identity feelings influence speech patterns. Although repetition tasks were initially included in our study, the stimuli used for its design did not allow us to properly address the studied phenomena.

Apart from this, due to the COVID-19 pandemic, participant availability led our study to include only female participants. As has been shown in other studies on spirantization and/s/lenition, male speakers may exhibit more variation than female speakers. For this reason, future studies should aim for more balanced gender representation to better capture the full spectrum of variation within this bilingual community. This is crucial, particularly considering previous studies that highlight the significant role of gender in such linguistic analyses.

Another possible limitation lies in the classification of participants into generational groups. We believe that this classification based on age-based profiles may obscure deeper sociolinguistic differences within each generation. Although our study identified cross-generational differences and continuums, further research is necessary to uncover the true sociolinguistic dynamics lying beneath.

Finally, while appropriate statistical models were employed to analyze the data, there is a possibility that alternative or more advanced modeling techniques could better accommodate the complexities of phonetic variation observed in Uruguayan Spanish. Future research could explore and apply multivariate models that can look at larger interactions. While we found all acoustic measures to be informative, we do believe relative intensity should be treated with care at the moment of generalizing findings.

To sum up, we believe that addressing all these limitations in future studies can ultimately contribute to more robust findings. We aim to continue working on describing the phonetics and phonology of Uruguayan Spanish and contributing to a better understanding of Uruguayan border speech.

Author Contributions: Conceptualization, V.M.A. and Owen Ward; methodology, V.M.A. and Owen Ward; software, O.W.; validation, O.W.; formal analysis, V.M.A. and O.W.; investigation, V.M.A.; resources, V.M.A. and O.W.; data curation, V.M.A. and O.W.; writing—original draft preparation, V.M.A. and O.W.; writing—review and editing, V.M.A. and O.W.; visualization, O.W.; supervision, V.M.A.; project administration, V.M.A.; funding acquisition, V.M.A. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declartion of University of Toronto, and approved by the Ethics Department (#39197, approved: 14/05/2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Appendix A

Full list of stimuli:

1. ¿Compraron bananas?
2. Sí, compraron bananas.
3. Compraron bananas, ¿no?
4. ¿Venden cebollas?
5. Sí, venden cebollas.
6. Venden cebollas, ¿no?
7. ¿Envolvemos todo?
8. Sí, envolvemos todo.
9. Envolvemos todo, ¿cierto?
10. Envolvemos todo, ¿no?
11. ¿Envuelven todo?
12. Sí, envuelven todo.
13. Envuelven todo, ¿cierto?
14. ¿Grabamos videos?
15. Sí, grabamos videos.
16. Graban videos, ¿cierto?
17. ¿Grabaron videos?
18. Sí, grabaron videos.
19. Grabaron videos, ¿cierto?
20. Grabaron videos, ¿no?
21. ¿Dónde trabaja?
22. ¿Dónde trabajan?
23. ¿Cómo vamos?
24. ¿Venden alfajores?
25. Sí, venden alfajores.
26. Venden alfajores, ¿no?
27. Venden alfajores, ¿cierto?
28. ¿Quiénes vienen?
29. ¿Cuántas vieron?
30. ¿Dónde viven?
31. ¿Volvieron temprano?
32. Sí, volvieron temprano.
33. Volvieron temprano, ¿cierto?
34. ¿Compramos yerba?
35. Sí, compramos yerba.
36. Compramos yerba, ¿cierto?
37. Compramos yerba, ¿no?
38. ¡Baje!
39. ¡Vamos!

Appendix B

Model outcomes: available https://drive.google.com/drive/folders/1gWsBfRfFgDJbj1jbxYysgMO5aiHKZG9C?usp=share_link (accessed on 8 July 2024).

Notes

1 All values reported as positive to avoid confusion.

2 For example, an interval divided into 6 frames with 3 frames containing voicing would be analyzed as 50% voicing.

3 Please refer to https://github.com/HenningReetz/Praat-scripts/blob/main/Pitch/Pitch_manual.pdf (accessed on 8 July 2024) and https://github.com/HenningReetz/Praat-scripts/blob/main/Pitch/Pitch_notes.pdf (accessed on 8 July 2024) for further details on the calculation system based on frames and its terminology, as well as for specific measurements used by Reetz (2022) to measure the three acoustic parameters.

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