REGIONAL VARIATION IN THE DEVOICING OF THE ALVEOPALATAL FRICATIVE IN ARGENTINE

EL ENSORDECIMIENTO DE LA FRICATIVA ALVEOLOPALATAL ASIBILADA Y SU VARIACIÓN REGIONAL EN ARGENTINA

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Artículo recibido el día: 15/07/2013
Artículo aceptado definitivamente el día: 20/10/2014
Estudios de Fonética Experimental, ISSN 1575-5533, XXIV, 2015, pp. 141-170

ABSTRACT

As is well known, Argentine Spanish demonstrates *žeísmo*, i.e., the voiced palatal phoneme /ʝ/, standard for most Spanish dialects, is realized as a voiced alveopalatal fricative [ʒ] or its voiceless counterpart [ʃ]. The variation of [ʒ] and [ʃ] has been shown to be conditioned by social factors such as sex, age, and social class (Wolf & Jimenez, 1977; Fontanella de Weinberg, 1978). The devoicing of [ʒ] has been described as a change in progress, led by younger, middle class, female speakers, and spreading to other groups in the populations studied (Wolf, 1984; Chang, 2008; Rohena-Madrazo, 2008, for Buenos Aires). The present study builds upon previous sociolinguistic analyses of *žeísmo* and takes a step towards a more comprehensive view of Argentine Spanish by investigating the allophonic variation in two lesser studied regional dialects of Argentina - Córdoba and Tucumán - as well as Buenos Aires. Spontaneous speech was collected from speakers in each of these three regions by use of a role-play elicitation exercise (*La encuesta porteña*, Gabriel *et al*, 2010). An acoustic analysis of the pronunciation of orthographic <y> and <ll> (in word-initial and intervocalic positions) measured duration, fundamental frequency, and intensity for these and surrounding segments of speech to describe voicing as a gradient production across regional and gender groups. Results show that females are devoicing more than males in Córdoba and Tucumán, with the most voiced productions coming from both genders of speakers in Córdoba. Males and females in Buenos Aires were not statistically different from one another, and these males devoiced significantly more (40% voicing) than those from Córdoba and Tucuman (both 95% voicing). This study presents the first recorded acoustic data for Tucumán, belonging to the northwest dialectal zone, and data for Córdoba, contributing to the very few publications with respect to this phenomenon (cf. Colantoni, 2005; Castellani, 1998). Additionally, the present study provides an acoustic analysis which considers the gradient nature of devoicing and quantifies the productivity of voicing among speakers from diverse populations.

Keywords: *žeísmo, Argentina, Tucumán, Córdoba, alveopalatal fricative, (de)voicing.*

RESUMEN

Como es bien sabido, el español argentino demuestra žeísmo, i.e. la aproximante palatal, /ʝ/, lo que constituye una pronunciación estándar en la mayoría de los dialectos del español, se pronuncia como fricativa postalveolar asibilada o sonora [ʒ] o sorda [ʃ]. Se ha demostrado que la variación de [ʒ] and [ʃ] está condicionada

por factores sociales, tales como el género, la edad, y la clase social (Wolf & Jimenez, 1977; Fontanella de Weinberg, 1978), y que el ensordecimiento se describe como un 'cambio lingüístico en marcha', propulsado por hablantes femeninas, jóvenes, y de clase social media que se extiende a los otros grupos en las poblaciones estudiadas (Wolf, 1984; Chang, 2008; Rohena-Madrazo, 2008, for Buenos Aires). La investigación que se presenta aquí amplía los análisis previos sociolingüísticos sobre el žeísmo, y avanza hacía una vista más completa del español a través de la investigación de la variación alofónica en dos dialectos menos estudiados en Argentina – los de Córdoba y Tucumán – además del dialecto de Buenos Aires. Se grabó el habla espontánea de hablantes en cada una de estas tres regiones a través de un instrumento que elicita una reacción oral frente a situaciones hipotéticas (La encuesta porteña, Gabriel *et al*, 2010). Después, un análisis acústico de la pronunciación de 'y' y 'll' ortográficos (solamente en posición inicial de palabra y posición intervocálica) midió la duración, la frecuencia fundamental, y la intensidad como producción gradiente entre grupos divididos por región y género. Los resultados demuestran que los hablantes féminas en Córdoba y Tucumán producen una fricativa ([ʒ]) más sorda que la de los hablantes varones de la misma región, y que las producciones más sonoras vienen de ambos géneros de Córdoba. Entre los dos grupos de género, los hablantes de Buenos Aires no mostraron ninguna diferencia estadística significativa, mientras los varones de este grupo produjeron fonemas mucho menos sonoros (40% de sonoridad) que los varones de Córdoba y Tucumán (ambos 95% de sonoridad). Este estudio presenta los primeros datos acústicos grabados en Tucumán, el cual pertenece a la zona dialectal noroeste, y también datos de Córdoba, un dialecto que ha sido poco estudiado en relación a este fenómeno (cf. Colantoni, 2005; Castellani, 1998). Finalmente, este estudio provee un análisis acústica que toma en cuenta la naturaleza gradiente de la sonoridad además de cuantificar la producción de ella entre hablantes de poblaciones diversas.

Palabras clave: *žeísmo, Argentina, Tucumán, Córdoba, fricativa asibilada, ensordecimiento.*

1. INTRODUCTION

1.1. Palatal assibilation in Argentine Spanish

The evolution of the palatal phonemes /j/ and /ʎ/ in Spanish has resulted in much variation through time, and across speakers of Spanish. The fusion of the two

phonemes in the process of *yeísmo* has since produced multiple realizations that are applied equally for orthographical <y> and ll>; and yet show socially conditioned variation across populations of speakers. Many studies have focused on Argentine Spanish in particular, where the already fused phonemes underwent a process of strengthening in the mid-18th century. This resulted in assibilation and a posterior palatal contact of the phoneme to produce both voiced [ʒ] and voiceless [ʃ] variants of the alveopalatal fricative (Fontanella de Weinberg, 1973), which is referred to as *zeísmo*, *žeísmo*, or *ʒeísmo*.

Almost all of the previous work investigating the *žeísmo* phenomenon in Argentina has focused on the alternation of these two variants among speakers of the littoral, or Río de la Plata dialect zone[1] in and around the capital, and largest city, Buenos Aires (c.f. Malmberg, 1950; Wolf and Jimenez, 1977; Wolf 1984; Fontanella de Weinberg, 1973, 1990; Chang, 2008; Rohena-Madrazo, 2013; Colantoni, 2013). Very few studies have examined the realizations of the palatal phoneme /ʝ/[2] in other dialect regions of Argentina, and most of these take an impressionistic observation approach listing the allophones for <y> and <ll> in a given dialect. For instance, the Spanish spoken in Córdoba, the second largest city of Argentina and belonging to the Central dialect zone, is discussed by only a few studies describing the distribution of the palatal phoneme. In 1991, Prevedello *et al*'s impressionistic study claimed that the voiced fricative palatal [ʝ] was the norm for the upper social classes of Córdoba, while the palatal approximant [ʎ] was associated with the lower classes. They admit that the *rehilado* (assibilated) palatal also occurs, but is not associated with a social stigma (Prevedello *et al*, 1991). In a more recent, experimental, study of assibilation processes in Cordoban Spanish, Colantoni affirms the use of the assibilated palatal in this variety, stating that [*they] are spreading into new dialectal areas in Argentine Spanish, while assibilated rhotics are being replaced by trills* (Colantoni, 2005:315). Lastly, Castellani (1998) compared speakers of different ages and genders from Buenos Aires (city), Córdoba (city), Rosario (city), and Tandil (a small town in Buenos Aires province) to measure their production of the palatal phoneme. She found the group with the highest rates of voicing were from Córdoba and included both males and females. Conversely, preference for the voiceless variant correlated with certain speaker profiles, specifically male speakers, speakers in larger and more 'prestigious'

[1] These dialect regions are based on the 5 dialect regions from Vidal De Battini (1964).

[2] This phoneme varies across dialects of Spanish outside of Argentina as well, but is often phonologically represented as /ʝ/ which is probably the most frequently occurring allophone for orthographical <y> and <ll> in word initial and intervocalic position.

cities, and younger speakers (Castellani, 1998). At present, no phonetic studies have been conducted in the northwest region of Argentina, which includes the province of Tucumán, with regards to *žeísmo*. The present study is dedicated to the investigation of the alveopalatal fricative in previously unstudied dialects of Argentina, specifically in Córdoba (Central dialect zone) and Tucumán (Northwest zone), as they compare to Buenos Aires (Littoral zone). As the following section shows, there have been many extralinguistic factors found to correlate with the degree of voicing, or devoicing, of the alveopalatal fricative and other phonemes.

1.2. The social correlates of devoicing

The 'žeísmo' pronunciation of the palatal phoneme /ʝ/ is possibly one of the most recognizable features of Argentine Spanish. While non-Argentine Spanish speakers may not distinguish between the voiced and voiceless variants, Argentines appear to be aware of this variation, (c.f. Colantoni, 2008; King, 2009; Rohena-Madrazo, 2011), which previous research has shown to be socially meaningful. For example, Malmberg (1950), Wolf and Jimenez (1977), Wolf (1984), Fontanella de Weinberg (1973, 1990), and Chang (2008) describe the voicing behavior of the alveopalatal fricative as 'a change in progress'. Fontanella de Weinberg (1990) reports that the alternation of the voiceless [ʃ] and voiced [ʒ] fricative among women in the province of Buenos Aires showed a higher frequency of voiced fricative [ʒ] as opposed to the devoiced alternate [ʃ], specifically for younger groups (under 30 years) during the decade of her 1975 study. More recent studies of this phenomenon have described the change to be progressing towards a more devoiced variant, and led also by young, female speakers (Chang, 2008; Rohena-Madrazo, 2008, 2013). Wolf and Jimenez (1977) found in their study of Buenos Aires Spanish that speaking style (formal vs. informal) did not have a significant effect on the degree of devoicing while sex and age did. Females devoiced the alveopalatal fricative significantly more than the males of the same study (15.57% to 3.32%), and the younger speakers also used the devoiced variant more than the older speakers (21.53% to 4%) (Wolf and Jimenez, 1977:300). Furthermore, Rohena-Madrazo (2013), and previous researchers, describe the devoicing in Buenos Aires Spanish as a 'bottom-up' type of change, citing Labov's ([1972], 2001) use of the term to complement top-down change in which speakers consciously acquire what is often viewed as a careful style of speech. A linguistic innovation that is adopted in a bottom-up fashion indicates an absence of consciousness on the part of the speaker, who is unaware of their change in behavior in adopting the new sound. While Wolf and Jimenez (1979) did not believe devoicing behavior was employed stylistically, the more recent studies

suggest otherwise (c.f. Rohena-Madrazo, 2008, 2013). Rohena-Madrazo finds a higher degree of voicing in more careful styles as well as differences between social groups, particularly dividing the middle and upper class younger speakers (2008). The bottom-up nature of the devoicing innovation reported by the researchers mentioned here is evident in its having been led by middle-class speakers (Rohena-Madrazo, 2013), but does not necessarily preclude it from showing variation between groups or styles of speech.

Devoicing behavior has been found to index social affiliation cross-linguistically as well. The Japanese data collected by Imai (2010) are characterized by an increase of vowel devoicing as the speech style becomes more informal (2010). Additionally, younger male speakers devoice the most of all groups, and the younger females the least. Imai explains this by associating covert and overt prestige with the desires of young female and male speakers (2010). Morris's work on Japanese vowel devoicing uses a perception study, testing the regional stereotypes associated with devoicing in Osaka and Tokyo (2010). Vowel devoicing appears to be an indicator of standard speech associated with Tokyo, and non-devoicing is viewed as a nonstandard form (Morris, 2010). The results from these studies are important in considering the patterns and implications of speaker gender and dialect region on devoicing behavior, both of which are the focus of the present study. The following sections present and describe the methodology, results and discussion.

2. DATA COLLECTION AND ANALYSIS

2.1. Speakers and materials

A total of 17 speakers from three different dialect regions of Argentina participated in this study (ages ranged from 22 to 42 years old; mean of 30 years). These were balanced approximately by region and sex: Buenos Aires = 5 (2 female, 3 male); Córdoba = 6 (3 female, 3 male); Tucumán = 6 (4 female, 2 male). All speakers were highly educated (having completed at least some university-level coursework) and, if not current university students, held professional level employment (requiring at least a high school education). The subjects were also screened for bilingualism. As a result of their education all subjects reported some experience learning English to varying degrees; the most proficient had attended bilingual schools and spent time in foreign countries, but none were bilingual from

childhood. Participants were recruited through local contacts of the researcher and participated voluntarily; data were collected in 2009.

All participants were interviewed in their respective city of origin. Individuals met with the researcher and participated in a role-play type survey. Recordings were made with a Marantz Solid State digital recorder and a lapel mic in a quiet room, which was usually in the subject's home or place of work. The survey used to gather data, *La Encuesta Porteña* (Gabriel *et al*, 2010)[3], is formulated to elicit a variety of intonation contours and requires the participant to respond spontaneously, taking the role described to him or her in different interactions. The responses varied from one word to multiple utterances according to the situation, but the survey elicited speakers to produce almost identical structures and words as the situations are very narrowly defined. For example, the researcher's oral elicitation 'Estás en tu casa con tu hija, María, que está mirando tele. Decíle que salís un momento a comprar', generally elicits an oral response approximating: 'María, salgo un momento a comprar' (my translation: You are at home with your daughter María, who is watching TV. Tell her you are leaving for a minute to buy something… 'María, I'm going out for a minute to buy something.) Subjects were cooperative in the role-play aspect producing a natural-sounding response for the situation. Some subjects asked questions or re-recorded when they were unsure of how to respond. All subjects completed a personal questionnaire which confirmed that they had been raised and spent their lives in the region of study.

2.2. Procedure

2.2.1. Segmentation

This section describes the segmenting of the target words into their individual sounds for the measurement of /ʒ/[4]. These were extracted from long files of spontaneous speech and segmented in Praat (Boersma & Weenink, 2010) resulting

[3] Also available from *Atlas interactivo de la entonación del español*, i.e. http://prosodia.upf.edu/atlasentonacion/metodologia/encuestas/encuesta-argentina.doc. The first cited work using this inductive method of data collection was Kasper & Dahl (1991). Research methods in interlanguage pragmatics. *Studies in Second Language Acquisition* 13, 215–247.

[4] Here I use /ʒ/ to designate all allophones produced for orthographical <ll> or <y> in word initial and intervocalic position. These allophones included [ʒ], [ʃ], and in a few cases [ʝ] or [tʃ].

in a total of 412 tokens. The first step of the segmentation was to search the recordings for words with orthographical <ll> or <y> in word initial or intervocalic position (in other positions the correspondence of phonic and graphic level for <y> lends either a vocalic realization /i/ (e.g. *papas y* [i] *tomates*) or a diphthong , as in *rey* [rej]). This was done in order to collect all cases of the target phoneme, /ʒ/ from the spontaneously produced speech. The word containing /ʒ/ and the preceding word if /ʒ/ was in word-initial position were segmented to individual sound files. The full utterance for each token of /ʒ/ was transcribed. In some cases, one utterance contained more than one instance of /ʒ/, rendering two tokens. For example, *'eh, yo te llamé antes'* produces one token from *yo* and another from *llamé*. Next, the target phoneme /ʒ/ was further segmented to isolate it from its surrounding phonemes. The vowel following the target phoneme /ʒ/ was used in the acoustic analysis for comparison with the target phoneme (in the above example it would be /o/ in the first token and /a/ in the second token).

Each sound file was uploaded to Praat and a text grid was made for the segmentation process. The boundary between the target phoneme /ʒ/ and the vowels that surround it was determined by the transition of periodicity in the waveform and placed at the nearest zero crossing. This was confirmed by examination of the spectrogram energy at high frequencies for the fricative. The boundary between two vowels was determined by viewing the formant transitions in a narrow-band spectogram. When the target word was in utterance-final position, the end point was marked at the point where the intensity drops to 50 dB. The recordings provided 440 occurrences of /ʒ/, from which 28 were discarded (resulting in 412 tokens) as they lacked clear boundaries surrounding the target consonant and surrounding vowel(s).

Once vowel-consonant boundaries were marked in the text grids, the corresponding segments were labeled for measurements to be taken. The syllable containing the target phoneme was labeled for two main parts: the target phoneme 'C' (the consonant /ʒ/) and its accompanying vowel 'V'. If the syllable ended in a consonant (i.e. was a closed syllable), the final consonant was not included in this combined measure, so as to allow for comparison with tokens of open syllables. Thus, for the word *Guillermo*, the target syllable is closed, (e.g. /ʒeɾ/), so we include only the segments C=/ʒ/ and V=/e/ for measurement (see figure 1).

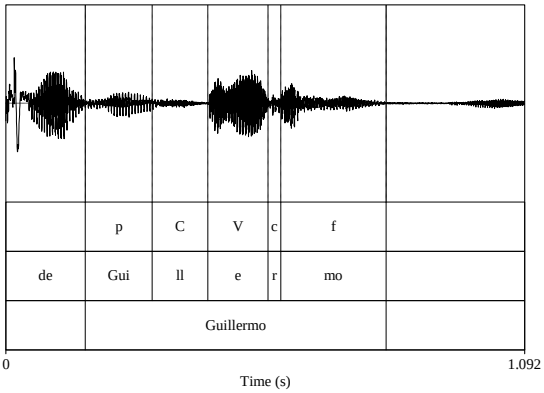

Figure 1. *Segmenting of token word* Guillermo *for speaker Tu06_10.*

2.2.2. Measurements

A recent study by Rohena-Madrazo (2010) examined the degree of voicing and devoicing of the alveopalatal fricative /ʒ/ across different speakers of Buenos Aires Spanish. The present study employs Rohena-Madrazo's technique of measuring the fundamental frequency in hertz using a Praat script which takes measurements from 21 equally spaced points along the duration of the token. While this methodology is able to describe voicing as a continuous variable (% voicing), the measurements are limited to one source (F0 of the token) and are constrained by how well Praat software can find and measure the fundamental frequency for this fricative. Considering how this type of analysis might not account for all acoustic properties of voicing of the alveopalatal fricative, the present study proposes to examine other acoustic properties of the token consonant to more precisely account for voicing in its gradient realizations for natural speech.

Thus, to examine voicing (or devoicing) of the target consonant /ʒ/, we measure the fundamental frequency (in hertz) as described above, as well as two other types of measurements: duration and intensity. These measurements are performed by automated Praat scripts upon the segmented phones of interest: the target consonant /ʒ/ and the vowel within its syllable, and the segments of the syllables preceding and following the target. An acoustic, rather than impressionistic method of study, allows for multiple measures associated with fricative production and

voicing to be examined with precision and without bias. This test looked specifically at the duration of the alveopalatal fricative /ʒ/ due to its correlation with voicing for production and perception. The perception of fricatives is not only determined by vocal cord vibration; when produced with a duration of less than 70 ms a fricative may be perceived as voiced, even if the sound is completely voiceless (Stevens *et al*, 1992). Other studies have found that the frication interval is longer and the preceding vowel is shortened for voiceless fricatives (Crystal and House, 1988).

The intensity for these same segments is measured in order to compare the minimum intensity of the target consonant /ʒ/ and the maximum intensity of the vowel following the target consonant. If the consonant and vowel are similar in intensity this means that the consonant, /ʒ/, is more vocalic/less consonantal, which means it is less strengthened. The palatal has to undergo a process of strengthening before it can undergo the process of devoicing. The difference of the two intensity levels correlates with the degree of constriction of the consonant. This constriction is of course associated with the process of devoicing in that a greater intensity difference between the vowel and consonant means a greater constriction of the consonant and greater devoicing[5].

This array of measurements is expected to give a more complete picture of the acoustic effects of voicing. The linguistic factors associated with voicing (duration, F0, and intensity) and the extra-linguistic factors *Region* and *Sex* of the speaker were tested by Mixed Models (linear) Regression for the groups of speakers to provide a comprehensive view of devoicing behavior. It's important to note here that of the 412 tokens measuring the phonetic production of orthographic <ll> or <y>, six of them included phonemes other than the alveopalatal fricative [ʒ] or [ʃ]. These included five cases of the palatal [j] and one case of the voiceless affricate [tʃ]. The productions were confirmed by observing steady formants across the duration of the palatal, uninterrupted voicing, a smooth waveform, and a lack of high frequency energy on the spectrogram, which is present in both voiced and unvoiced productions of the alveopalatal fricative. The affricate [tʃ] was identified by a decrease in waveform energy preceding the stop and the burst, visible also on the spectogram. These six occurrences were produced by four different male speakers, two from Córdoba and two from Tucumán and represent allophones

[5] The use of intensity ratios as a measure for consonant constriction was suggested by Laura Colantoni (2013, personal communication) and is evident in her studies (2005, 2006) as well as Chang (2008). However, she adds that this type of measurement is more relevant for stops as it is indicative of the intensity/voicing relationships of the sonority scale.

native to their respective dialects. Their very low occurrence rate helps to justify the focus of the present study, which is on the production of the assibilated variants. In consideration of this objective the measurements of these six tokens were not included in the statistical tests reported here.

The data were analyzed with a series of mixed-model regression pairwise comparisons (adding and subtracting factors from a null model, or a 'step-up step-down' test in Rbrul (Johnson, 2009) version 2.23, run on R version 3.0.2 (R Development Core Team, 2008). A separate model was built for each of the dependent variables: the voicing of /ʒ/ (i.e. the alveopalatal fricative), the duration of /ʒ/, the difference between the minimum intensity of /ʒ/ and maximum intensity of the vowel in the same syllable, and the ratio of the duration of /ʒ/ to its accompanying vowel (V). For each of the models, and thus, dependent variables, the external factors *Region* (Buenos Aires, Córdoba, Tucumán) and *Sex* (male, female) were entered as independent fixed variables. The interaction of the two was also built into each model. Finally, and in addition to the external factors, each participant (*Subject*) was entered into the models as a random intercept. The results of these tests that were found to be significant (below the alpha level 0.05) and the descriptive statistics for each measure are reported separately in the Results section.

3. RESULTS

3.1. Social factors of voicing: region and sex

The social factors Region and Sex are tested with measures that either describe or correlate with the voicing of [ʒ]. The first measure reported here, C(/ʒ/) percent voicing, directly reflects the vibration of the vocal folds in the production of the consonant [ʒ]. The F0 was measured (in hertz) at 21 points equally distributed across the duration of [ʒ]. The proportion of points resulting in an F0 reading is represented as a percentage to describe the overall degree of voicing for the consonant, following the methodology and Praat scripts of Rohena-Madrazo (2010). For the continuous dependent variable of C percent voicing, the best fitting step-wise regression model with *Subject* as a random intercept found *Region* as a significant Fixed Effect ($p<.01$). Córdoba had the highest mean for C% voicing (i.e. the least devoicing) with 89%, and Buenos Aires the lowest with 46%, while Tucuman falls in the middle with 68% mean voicing. *Sex* did not show a main

effect for voicing of the palatal fricative as it was added or removed to the mixed model tests (table 1).

Cpercentvoicing random.intercept: Subject	
Deviance	3950.624
AIC	3944.801
Df	5
Intercept	69.775
Grand mean	67.875%

Region	Log odds	Tokens (n)	Mean %
Buenos Aires	-21.824	121	46.242
Córdoba	20.947	126	88.927
Tucumán	0.876	159	67.655

Table 1. *Rbrul analysis of /ʒ/ percent voicing.*

A post-hoc (LSD[6]) test was done to compare the three regions, finding each of them to be significantly different from one another ($p<.01$). As can be seen in figure 2, each of the 3 regions resulted in differing means for the male and female speakers, although these did not produce a significant fixed effect in the mixed model. Specifically, the difference between the men from Buenos Aires in their C%voicing with a mean of 40.3% from those in Córdoba (94.7%) and Tucuman (95%) is apparent in these descriptive statistics, as well as the relatively high voicing mean by Córdoba women (85.6%).

[6] A Post-Hoc LSD (Least Significant Difference) is a protected t-test that uses a more conservative estimate of variance to protect the test from a type I error and is used for comparing 3 groups or less.

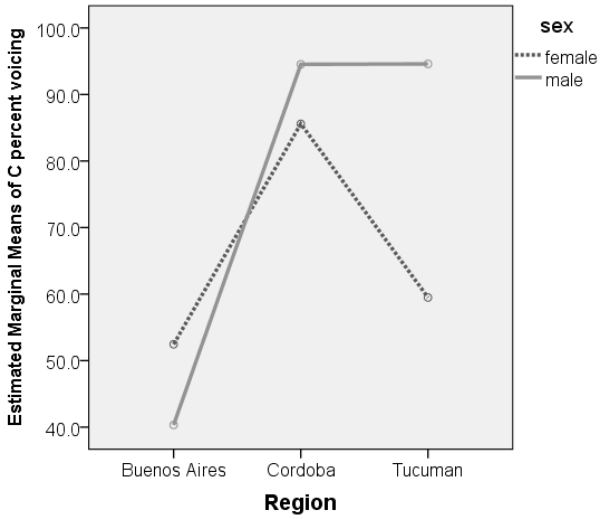

Figure 2. *Mean percent voicing of target consonant /ʒ/ for speakers by* Region *and* Sex.

The duration measures showed similar trends of significance as C % voicing, with respect to the factors *Region* and *Sex*. A mixed-model regression test (step-up step-down) was fit with the duration of the consonant (/ʒ/) as the dependent variable and the random intercept *Subjects*, and found the best fitting model to include *Region* ($p = 0.018$, table 2). The means were significantly different between all three regions: Córdoba (69 ms), Buenos Aires (98 ms) and Tucumán (85 ms), as found with a post-hoc (LSD) test ($p<.01$).

Although *Sex* did not result as a significant fixed factor in the multiple regression test, the means for the different *Sex/Region* groupings can be observed in figure 3. The lack of difference between men and women speakers in both Buenos Aires and Córdoba is apparent in the combined lines, while Tucumán speakers show a strong sex division regarding the duration of /ʒ/. Considering the nature of voiced productions correlating with shorter frication intervals (relative to voiceless productions, Crystal & House, 1988), the results for duration and voicing conjointly provide evidence for a more devoiced production by Buenos Aires speakers and Tucumán women, and a highly voiced (>85% voicing) production by Cordoban speakers and Tucumán men.

Cduration random.intercept: Subject	
Deviance	-1862.686
AIC	-1825.778
Df	5
Intercept	0.082
Grand mean	84 ms

Region	Log odds	Tokens (n)	Mean (ms)
Buenos Aires	0.014	121	98
Córdoba	-0.013	126	69
Tucumán	-.001	159	85

Table 2. *Rbrul analysis of /ʒ/ duration.*

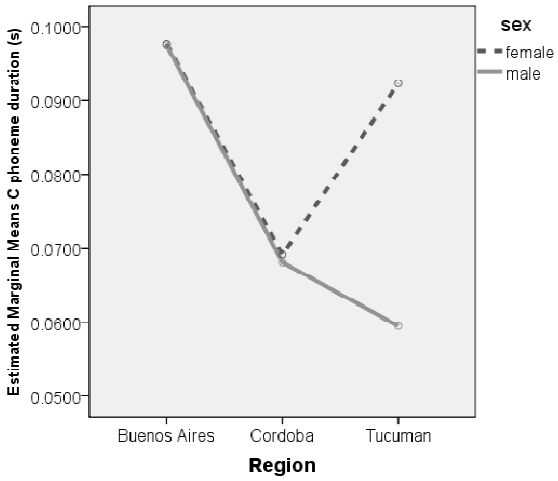

Figure 3. *Mean duration of target consonant /ʒ/ for speakers by* Region *and* Sex.

The difference of intensity (between the minimum intensity of the target consonant /ʒ/ and maximum intensity of the vowel in the same syllable) was tested with *Subject* as a random intercept and *Region* and *Sex* as independent fixed factors. The best fitting model included *Sex* ($p<.01$) and *Region* ($p<.01$) as significant factors in the difference of intensity, but their interaction was not significant (Table 3).

Post-hoc testing revealed that Córdoba's mean difference of intensity (12.4 dB) was significantly different from both Tucumán (16.8 dB) and Buenos Aires (16.1 dB), who both showed a nearly identical difference of intensity between the target consonant and vowel. Similar to the findings for F0 (C % voicing), this means that as a region, the Córdoba speakers produced a higher intensity for the consonant, approximating that of the vowel. This is indicative of a more voiced and/or less constricted consonant than that which was produced by the speakers from Buenos Aires and Tucuman. When divided by sex, a post-hoc (LSD) analysis shows that females in Córdoba (14.1 dB) had a significantly lower mean difference of intensity than the females of Buenos Aires (18.1 dB) and Tucumán (18.8 dB) ($p<.01$). This indicates a higher intensity production of /ʒ/. The males in Buenos Aires (14.2 dB) showed a significantly higher mean difference of intensity than the males of Córdoba and Tucumán (both 9.9, $p<.01$), indicating a less voiced and/or more constricted production of /ʒ/ (see table 3 and figure 4).

DifferenceIntensity (Cmin-Vmax) random.intercept: Subject	
Deviance	2532.078
AIC	2540.13
Df	6
Intercept	14.472
Grand mean	15.304 dB

Factors	Log odds	Tokens (n)	Mean (dB)
Region			
Buenos Aires	1.950	121	16.096
Córdoba	-2.531	118	12.469
Tucumán	0.581	156	16.835

Sex			
Female	2.574	250	17.288
Male	-2.574	145	11.884

Table 3. *Rbrul analysis of intensity difference (Min /ʒ/ - Max V).*

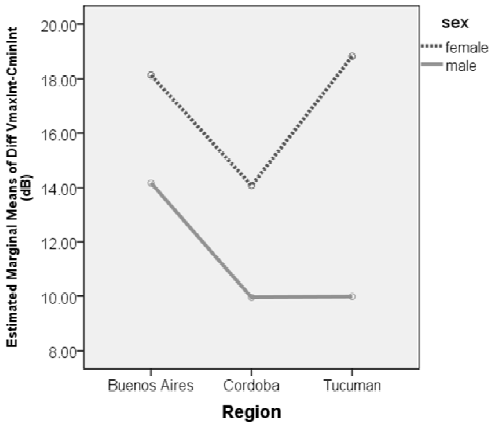

Figure 4. *Difference between minimum intensity of target consonant, and maximum intensity of target vowel.*

The duration measures were recalculated to form a new variable that describes the ratio of the duration of /ʒ/ divided by the duration of its accompanying vowel in the target syllable, or, (durC/durV)[7]. This ratio gives an additional view of the perceptual effects of consonant voicing. A number of 1 or greater signifies a consonant duration exceeding that of the vowel that would likely be perceived as more voiceless. A lower value signifies a more equal Consonant-Vowel ratio, and would be likely to be perceived as more voiced, following Crystal and House (1988). The

[7] The use of a durational ratio to address the influence that relative durations have on voicing perception was suggested by an anonymous reviewer and thus added post-hoc to enhance the analyses presented in this paper. To him or her I am grateful for this suggestion.

best-fitting model for the CV duration ratio data with *Subject* as a random intercept included *Region* (p<.001) as a significant fixed effect.

The CV duration ratios for Buenos Aires (1.51), Tucumán (.948), and Córdoba (.73) were all significantly different from one another in a post-hoc LSD test (p<.01). The only region in which this duration ratio showed a sizable difference between male and female speakers was Tucumán, with males having a much lower ratio (.71) than females (1.02). In Córdoba and Buenos Aires the males and females had very similar durational ratios for the consonant and vowel of the target syllable (table 4).

RatioCdurVdur random.intercept: Subject	
Deviance	4500.422
AIC	4492.861
Df	5
Intercept	1.038
Grand mean	1.049

Region	Log odds	Tokens (n)	Mean
Buenos Aires	43.020	121	1.512
Córdoba	-30.231	126	.731
Tucumán	-12.789	159	.948

Table 4. *Rbrul analysis of CV duration ratio.*

3.2. Lexical influence on voicing

In order to test the potential variation in voicing presented by individual lexical items, the six most frequently produced tokens were selected from the data for further analysis. It is important to note that this analysis is not meant to address frequency effects or specific lexicon regarding the Spanish language in general. Instead it intends to account for the fact that the role-play methodology used to

elicit speech, and thus the data from which tokens of /ʒ/ were extracted, resulted in certain lexical items being repeated by the subjects in their responses. The three most highly frequent words, *yo, ya*, and *mayo*, were spoken at least once by each subject. The specific verb forms *llenar, llegué,* and *llegó* were the next most frequent lexical items, being spoken by most of the subjects at least once (table 5). The two most highly frequent words in the corpus, *yo* and *ya*, are frequent in spoken Spanish in general, but the other highly frequent words reflect the elicited responses shaped by the situations presented in the data collection instrument.

In looking at the mean percent voicing per word, there are no unusual patterns, which is to be expected since the subjects are all grouped together. When the words are measured for mean percent voicing by sex, there is one significant case for the word *ya* (one-way ANOVA, $F(1,66)=1.362$; $p<.05$). Women voiced the /ʒ/ in *ya* significantly less than men. The same measure of C % voicing tested for *yo* showed the same division for sex, but not at a significant level ($p=.06$).

Word	N	Mean % voicing	Standard Deviation
yo	78	56	40.7
ya	55	71	37.0
mayo	21	57	40.5
llenar	18	76	33.3
llegué	18	78	30.7
llegó	18	53	41.7

Table 5. *Most frequent words containing /ʒ/ from spoken corpus*.

4. DISCUSIÓN

In isolating and measuring tokens of the alveopalatal fricative /ʒ/ we have shown how its degree of voicing relates to several linguistic and extra-linguistic factors. This section will discuss how the main effects investigated in this study, *Sex* and

Region (Tucumán, Córdoba, and Buenos Aires) appear to be influencing the voicing of /ʒ/[8].

4.1. Tucumán

The sex preference for the devoicing of /ʒ/ is shown most consistently and strongly in the data coming from the Tucumán speakers. As evidenced by the results of the present study, the women devoiced more than the men from this region and at a similar degree as the women speakers from Buenos Aires. The results from the intensity measurements also group Tucumán women with those from Buenos Aires; together these two groups were significantly different from all other sex and regional groups. This could be representative of a change in progress towards devoicing being led by women (specifically in and/or around Tucumán), similar to that which was reported in previous studies from Buenos Aires (Wolf and Jiménez, 1979; Wolf, 1984; Chang, 2008; Rohena-Madrazo, 2008). The possibility that women are changing towards a more devoiced production is evidenced in their results in almost all measures made in this study, thus differentiating them from the Tucumán men who consistently produced highly voiced alveopalatal fricatives [ʒ]. Specifically, the duration means support the voicing results by showing a negative correlation, (e.g. the duration of the frication interval for voiceless fricatives is greater than for voiced fricatives as described by Crystal and House, 1988). While the fixed factor *Sex* was not selected for the best regression models with the dependent variables of voicing and duration of /ʒ/, the means differentiating men and women speakers in Tucumán coincide across all of the measures performed in this study. They consistently indicate a productive divide with regards to the pronunciation of /ʒ/ (see Figure 6 for a summary of results). Consequently, Tucumán was found to have the most significant gender divide in this study, when compared to the results for Córdoba and Buenos Aires.

Lastly, as the first experimental study investigating the production of /ʒ/ by speakers from Tucumán, it's important to note that the first observations of this portion of the data revealed an almost exclusive use of the assibilated variant (the alveopalatal fricative) as opposed to the semiconsonant /j/, which characterized

[8] The statistical tests performed on these measurements consistently found one or both of the main effects (*Region* and *Sex*) to be significant but not the interaction of these factors. This is likely to be due to the inclusion of *Subject* as a random intercept reducing the number of tokens for each group. Since the data suggest an interaction of *Region* and *Sex* (as visualized by intersecting lines on the graphs) a larger data set with the same tests may result in statistically significant interaction results.

only a few tokens. It had been previously observed by Rojas (2000) that in the Northwest Region of Argentina the phonemic production of *yeísmo* was differentiated by the speaker's social class and/or proximity to urban centers, with urban, middle to higher class speakers preferring the assibilated /ʒ/ production to the semiconsonant /j/. Rojas' earlier observation is substantiated by the data collected from the speakers in this study, who were younger and educated from in and around the capital city San Miguel de Tucumán.

4.2. Córdoba

As a region, Córdoba was consistently different from Buenos Aires and Tucumán in the statistical models testing the four dependent variables. Córdoba speakers showed the highest mean for voicing and the lowest mean for duration, both describing the acoustic production of /ʒ/. Córdoba speakers also stood out compared to the other two regions with respect to the difference in intensity between /ʒ/ and the following vowel, showing the smallest difference in intensity. This indicates that the consonant is produced with less constriction, signifying a /ʒ/ production that is late in advancing towards a devoiced production, or not advancing that direction at all. The ratio of duration between the /ʒ/ and the following vowel, another correlate of voicing, also resulted in Córdoba diverging from Buenos Aires and Tucumán as a *Region* in mixed-model analysis. Córdoba's mean of .731 in this ratio, the lowest of the three regions, illustrates a durationally shorter consonant relative to the vowel in the same syllable. All of these measures point to a more voiced production of /ʒ/, as compared to the other two regions tested.

With regards to sex differences, the men from Córdoba and Tucumán have almost identical high means of voicing (95%), which are vastly different from those of Buenos Aires (40%, Figure 6). This leads us to believe that voicing may serve to distinguish these speakers from the *porteño* (Buenos Aires) men, but it is unclear if the Córdoba and Tucumán male speaker production of the alveopalatal fricative is socially distinguishing these two regional groups from each other.

The women speakers from Córdoba voiced significantly more than the other two regional female groups suggesting that they may be behind Tucumán in the progression towards the devoiced variant, or may not be progressing at all towards absolute devoicing. Instead, partial voicing may serve to distinguish them from both the men and the other regions. The findings presented here concur with the results from Castellani (1998) in which the women in Córdoba voiced more than

women in the other regions studied (which included Buenos Aires, Rosario, and Tandil, all within the Littoral dialect zone).

The evidence of high voicing is supported by the duration means, which are nearly identical and somewhat short (69 ms) for both the men and women from Córdoba. Given the non-significantly different means of voicing for men and women from this region, the lack of difference for duration leads us to wonder what, if any, perceptual difference exists between men and women of this region regarding their voicing of /ʒ/. With these low duration means, both men and women speakers of Córdoba are likely to be perceived as more producing voiced realizations of /ʒ/ (following Stevens *et al*, 1992 threshold of 70 ms for voiceless perception).

The difference in strengthening as determined by the intensity measures in this study can distinguish the Córdoba speakers from Tucumán speakers, even if both are voiced. Based on the data presented in this paper, specifically this measure of intensity, Córdoba seems to be unique in that it is behind both Buenos Aires and Tucumán in the process of strengthening (Córdoba average Intensity difference of 12.4dB, vs >16dB for Buenos Aires and Tucumán). The phonetic realization of *yeísmo* has separated Córdoba (as part of the Central dialect zone) from Tucumán and Buenos Aires in the past as well (c.f. Vidal de Battini, 1966). The two latter regions share an assibilated ('*rehilado*') production, while the central zone was described to have *yeísmo común o primario* pronunciation with the *'y' castellana*, or rather, the palatal [ʝ] (Vidal de Battini, 1966:126).

4.3. Buenos Aires

The results from this study suggest that the women from Buenos Aires may be subject to a different pattern of change than the Córdoba and Tucumán groups. Despite a low degree of voicing, the Buenos Aires women in this study actually voiced slightly more than men, although their means are not statistically different (52% voicing for women *vs*. 40% for men, table 6). The duration results support these low voicing means in that the longest durations were found in the population with the greatest devoicing, Buenos Aires.

The discussion of devoicing in Buenos Aires has historically considered the particular neighborhoods within and surrounding the city of Buenos Aires as a relevant social grouping (in addition to age and gender) for the devoicing phenomenon. The speakers in the present study present a limited and unbalanced profile of the different neighborhood groupings, which may have influenced the

results of this study. The women speakers from Buenos Aires were from neighborhoods just to the north of the center, while the male speakers were divided among central and northern neighborhoods. Previous studies of *žeísmo* in Buenos Aires have associated northern neighborhoods to upper social classes and to a more voiced pronunciation of /ʒ/ (Wolf, 1984; Rohena-Madrazo, 2008, 2013). This pattern is consequently supported by the small data set presented in this study.

Chang (2008) attests that at the time of his study the change in progress towards devoicing had stabilized in Buenos Aires. While the data from the present study concerning Buenos Aires as a dialectal area are not sufficient in number or diversity to confirm this conclusion, it is of the author's opinion that outside of the littoral zone, and specifically in Tucumán and Córdoba, the change toward devoicing is in progress. This is supported by the data showing women voicing significantly less than the men in these two regions (women vs. men = Córdoba 85% vs. 95%; Tucumán 59% vs. 95%). This would not be an unusual pro-gression for linguistic change to occur, since the littoral dialect zone, characteristic of greater Buenos Aires, represents the largest and most influential region in the country. Colantoni projected the assibilation of palatals and rhotics in the regions of Argentina exterior to Buenos Aires to be under this influence, and in turn converging towards the standard presented by Buenos Aires Spanish (Colantoni, 2005).

	Buenos Aires		Córdoba		Tucumán	
	women	men	women	men	women	men
Voiced portion of /ʒ/	52%	40%	85%	95%	59%	95%
Duration /ʒ/	98ms	97ms	69ms	69ms	92ms	59ms
Intensity /ʒ/	18.1dB	14.2dB	14.1dB	9.9dB	18.8dB	9.9dB

Table 6. *Summary of results for Regional and Gender groups.*

4.4. Lexicon

Finally, we return to the analysis of the specific lexical items found among the tokens for /ʒ/. The words in which the target sound occurs are not shown to influence the voicing of /ʒ/, except for *ya* which displays significantly lower means

of percent voicing for female speakers as compared to males. Possibly, this is merely a reflection of the voicing trend in general in which the majority of the females (i.e. from Tucumán and Córdoba) devoiced more than the majority of the males. The significance resulted uniquely for *ya* because this word was frequent among the tokens, thus lending a statistically stronger result for the ANOVA analysis. Conversely, this pattern could be interpreted as the result of a sound innovation, in this case, devoicing, following the process of *Lexical Diffusion* in which sound change is phonetically abrupt and lexically gradual and occurs through some, but not all lexical items at any given time (Wang 1969, *inter alias*). However, this conclusion cannot be confirmed with the data presented here. The nature of data collection was not adequate for revealing a potential lexical effect of voicing as it was not controlled for this purpose; this possibility should be further investigated using controlled speech including both high frequency and low frequency words.

The differences in voicing between speakers of different regions can be contexualized by sociohistorical and geographical features. Córdoba and Tucuman are geographically distant to each other and to Buenos Aires, and yet both maintain connections to the country's capital through media, roadways, and other paths, physical and otherwise. Throughout its history, Tucumán has been the regional center for trade and travel between Bolivia, Peru, the greater northwest Argentina and Buenos Aires; and Córdoba has had a similar role as gateway between Bolivia, Chile and Buenos Aires since 1773 (Rodas, 2003; Ávalos, 2000). Both regions, then, are seen as transition zones, with frequent contact from neighboring provinces (c.f. Donni de Mirande, 1984; Rodas, 2003). Tucumán holds the unique historical role as the '*corazón de la patria'* (Heart of the nation) of Argentina, since it was the site for the signing of the Declaration of Independence from Spain. These geographical facts, supported by their historical roles, place both regions in similar situations for language contact with Buenos Aires and their respective neighboring provinces and indigenous languages. This provides a foundation for different linguistic substrate and superstrate influences, but does not explain the different rates or directions of change for the alveopalatal fricative. We must consider other cultural aspects, where we find that Tucumán and Córdoba both are described as 'conservative' cultures, (Montaldo & Montaldo, 2002; Rodas, 2003). However, the Northwest region is said to be always changing and incorporating aspects of culture and language from both its indigenous and Hispanic roots, *Tenaz en conservar lo hispánico y lo indígena, pero al mismo tiempo dócil a las influencias de la cultura y el habla porteñas, la región argentina del Noroeste se diseña claramente distinta en el entorno nacional* (Rodas, 2003:27) ('Strong in conserving what is hispanic and indigenous, but at the same time docile to the

influences of Porteño culture and speech, the Argentine Northwest region makes itself clearly distinct in the national setting', my translation). In consideration of the acoustic results presented here, the greater devoicing of /ʒ/ by Tucumán women (relative to the Córdoba women speakers), is indicative of a change in progress towards the completely devoiced variant and makes Córdoba appear the more (linguistically) conservative dialect, despite the many sociohistorical features these two regions may share.

Of course, this is but one of many features that potentially distinguish one of these speakers from another group. The production of the trilled /r/ and intonation are also believed to differentiate these three dialects, as well as syntactic and lexical inter-regional variations. The alveopalatal fricative carries with it a strong association of Argentineness, and as the studies of žeísmo are gradually revealing, the characteristic /ʒ/ phoneme presents multiple social and linguistic factors influencing its realization along the voicing spectrum.

5. CONCLUSION AND FUTURE DIRECTIONS

The voicing and devoicing of /ʒ/ has been investigated for three regional varieties of Argentine Spanish: Buenos Aires, Córdoba, and Tucumán, representing the Littoral, Central, and Northwest dialect zones (Vidal de Battini, 1964). The focus of this paper was to provide insight into the progression of devoicing in Córdoba and Tucumán since much of the previous research on this phoneme has focused on the varieties belonging to the Littoral dialect zone. The methodology drew speech from a role-play exercise performed with men and women speakers, mostly in their 20's-30's and of middle to upper-middle class. Tokens of /ʒ/ were analyzed for fundamental frequency, duration and intensity to give a comprehensive view of the degree of voicing (or devoicing) of the target phoneme and the acoustic properties of this and surrounding phonemes that might influence the perception of voicing and differentiate speaker productions. Regional differences resulted for each of these measurements, and *Sex* was found to be significant as well in the difference of intensity in a linear regression model. Overall, women were found to devoice more than men in Córdoba and Tucumán, but not Buenos Aires. Men and women from Buenos Aires were not significantly different from one another while those from Tucumán consistently produced different means related to and including the voicing of /ʒ/, suggesting a change in progress led by the women of this region. In Córdoba, the women showed the lowest tendency to devoice, and men an even lower tendency, distinguishing this dialect from the others. The men from

Tucumán also voiced most of their production of /ʒ/. The two male groups could be seen as distinguishing themselves from Buenos Aires males who mostly devoiced.

This study was limited in more than one respect and merits additional research in order to enhance our knowledge of the voicing of /ʒ/, both in the perceptual and social saliency of this linguistic feature, and as it illustrates the progression of language change across diverse populations in Argentina. Future studies might consider measuring periodicity as well, following Colantoni (2006) in order to amplify the viewpoint on voicing. Additionally, a greater and more diverse number of speakers from these and other regions will shed additional light on the variations present for the realization of /ʒ/ and the continued documentation of its production. Continued attempts to diachronically document the productions of /ʒ/ will help us understand how sound change progresses and hopefully present a broader view of the diverse population of Argentina.

ACKNOWLEDGEMENTS: I appreciate the advice of Dr. Laura Colantoni and suggestions from two anonymous in the publication of this work.

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