Micro and Macro Sound Variation and Change in Argentine Spanish

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1. Introduction

Phonetic variation is pervasive. Variation could be ‘hidden’ (Ohala 1989) or apparent; it could be stable or unstable, resulting in sound change. As such, phonetic variation is a pre-condition for sound change (Ohala 1989). When phonetic variation results in a change in the inventory, phonological theory has to explain how new phonemes or allophones emerge and, in consequence, it has to explore the limits of phonetic variation and determine whether a change has occurred in isolation or in bundles. However, in order to expand our knowledge on the mechanisms of sound variation and change, and, in particular, to deepen our understanding of how phonetic variation may result in change, it is necessary to focus on a specific phenomenon occurring in a given variety. Thus, I will analyze here two on-going changes in Argentine Spanish, namely loss of assibilation in rhotics and assibilation in palatals, illustrated in (1):

(1) [ɹ̌]ubia > [r]ubia rubia ‘blonde’
[j]uvia > [ʒ]uvia lluvia ‘rain’

These processes affect the same phonetic dimension (i.e. periodicity); are attested in the same communities and individuals (see Colantoni 2001; 2005); may create grammars with two assibilated post-alveolar consonants, and thus trigger a series of changes. Thus, this paper aims at characterizing, first, the limits of this phonetic variation in the periodicity dimension, by determining the acoustic differences between rhotics and palatals. Second, it will demonstrate that a decrease in periodicity in palatals (assibilation) is accompanied by an increase in periodicity in rhotics (deassibilation). Third, and more importantly, I will show that this variation in the periodicity dimension is present at the micro phonetic level in all the varieties under analysis. Finally, I will address the issue of phonetic variation and phonological categorization, and I will suggest hypotheses about the final stages of these on-going changes. In order to achieve these goals, I will analyze conservative varieties that have been described as not undergoing these changes (Vidal de Battini 1964), represented here by San Juan Spanish, as well as those where the change has been reported to be in progress, i.e. Corrientes Spanish (Colantoni 2001).

The rest of the paper is structured as follows. In the first two sections, I discuss the acoustic differences between assibilated and non-assibilated palatals (§2) and rhotics (§3). I forward the hypotheses in §4, and I discuss the methodology used to test them in §5. Results are presented in §6, followed by an evaluation of the hypotheses in §7. I will conclude in §8 with a proposal about the emergence of the new variants.

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2. From non-assibilated to assibilated palatals

The on-going change in these Argentine varieties involves an increasing degree of assibilation; namely, the existing non-assibilated palatals are being replaced by sibilant fricatives. Assibilated and non-assibilated variants differ in several acoustic parameters, such as duration, voicing, intensity, frication noise frequency, and cepstral peak amplitude[1] (see Table 1). As concerns the direction of the change, I will assume that the underlying form is an approximant instead of a fricative for several reasons.[2] First, postulating an approximant allows us to account for the range of variation observed (a continuum from vowel-like segments to fricatives), and to interpret the change as a strengthening process or a sequence of strengthening processes. If the point of departure were a fricative, we would need to postulate a weakening process for some speakers (namely those showing more vowel-like segments), and a strengthening process for speakers of innovative varieties. Secondly, palatal fricatives are uncommon cross-linguistically (Ladefoged & Maddieson 1996: 165), whereas the phenomenon of glide-strengthening is quite frequent (Ohala, 1993; Ladefoged & Maddieson 1996). Indeed, Borzone de Manrique (1976: 122-3) demonstrates that even glides in word-initial position (e.g. *hielo* 'ice') show a more constricted articulation than in other positions in the word. As such, in any language or variety where approximants exist, there may be an alternation between weak and strengthened variants, including fricatives. Finally, a further stage in the process, i.e. the emergence of sibilant fricatives should also be phonetically motivated, since it would only involve an increase in the degree of constriction.

Dimension	Approximant	Sibilant fricative
Voicing	Voiced; some devoicing (Ohala 1993; 1997)	Voiced/voiceless (see Ohala 1993 for general aerodynamic principles; and Wolf & Jimenez 1979 for alternations in Buenos Aires Spanish)
Frication noise	Higher constriction in word-initial position (Borzone de Manrique 1976)	Buenos Aires Spanish: 3000-5000 Hz (Borzone de Manrique & Massone 1981); English (center of gravity): 4200-5300 (Jongman et al. 2000; Tabain 2001)
Cepstral peak amplitude	Not available	0.08 (Santagada & Gurlekian 1989)
Intensity	Absolute initial position: drop in intensity (Borzone de Manrique 1976). English: difference of -3.5 dB (Balakrishnan et al. 1996)	Spanish: change of 5-10dB (Gurlekian & Facal 1995). English (Balakrishnan et al. 1996; Jongman et al. 2000, respectively): [ʃ]: -13.7dB ; -9.9dB ; [ʒ]: -11.1dB; -8.3dB
Duration	16-38 ms; depending on speech rate and vowel context (Borzone de Manrique 1979)	Spanish (Borzone de Manrique & Massone 1981); [ʃ]: 170-210 ms; [ʒ]: 98-149ms; English (Jongman et al. 2000); [ʃ]: 178 ms; [ʒ]: 123 ms

Table 1: Acoustic differences between approximant and sibilant post-alveolar fricatives

3. From assibilated to non-assibilated rhotics

Interestingly, the change involving rhotics affects the same phonetic dimension (i.e. periodicity) but in the opposite direction, since assibilated rhotics are being substituted by non-assibilated ones. Assibilated and non-assibilated variants differ again in several phonetic parameters, which are summarized in Table 2 below.

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[1] The cepstral peak amplitude is a measurement of periodicity of a given sound (Santagada & Gurlekian, 1989). A value closer to 1 indicates a high periodicity where as values closer to 0 signal the presence of a noisier segment.

[2] This does not preclude the existence of fricatives in other varieties (see Navarro Tomás 1970; Díaz-Campos & Morgan 2002). Indeed, Díaz Campos & Morgan (2002: 264-66) show that Central American Spanish varieties have a more vowel-like articulation.

Dimension	Fricative rhotic	Trill
# of closures	Not applicable	2-5 (Recasens & Pallarès 1999); 3 (Quilis 1993; Blecua 2001; Solé 2002)
Voicing	Devoiced in 12.5% of tokens (Quilis & Carril 1971)	Voiced; some devoicing (Solé 2002; Lewis 2003)
Frication noise	Centered around F2; i.e. 2500 Hz (Quilis & Carril 1971)	Some friction after last closure (Quilis 1993)
Cepstral peak amplitude	Not available	0.09 (/i/ context); 0.14 (/a/ context) (Gurlekian et al. 1989)
Intensity	Not available	Change of 20-30dB from preceding vowel (Gurlekian & Facal 1995)
Duration	80-180 ms (Quilis & Carril 1971)	71-130 ms (Recasens & Pallarès 1999); mean duration 85ms (Quilis 1993)

Table 2: Acoustic differences between fricative rhotics and trills

Changes from fricative rhotics to trills have been reported for other Spanish varieties (e.g. De los Heros 1997). However, such a change would be difficult to motivate phonetically. Indeed recent articulatory studies (Solé et al. 1998; Solé 2002) predict a change in the opposite direction. Very precise aerodynamic conditions are required for trill production, and a small change in intra-oral pressure would lead to the production of a fricative. In order to produce a trill, instead, a speaker would have to learn to master the necessary aerodynamic conditions for trilling to occur. On the other hand, if the change were from a fricative trill to an approximant, it would only involve a manipulation of the degree of constriction.[3] Such a change would be consistent (i) with the observation that varieties traditionally described as having the standard trill show an alternation between trills and approximant rhotics (Hammond 1999; Blecua 2001); (ii) with alternations reported for other Romance languages, such as French (Straka 1979; Colantoni & Steele 2005). Thus, I will also argue that the change observed in rhotics stems from a phonetic micro variation, which is expected to be present even in speakers for whom the change is in initial stages. I expect, then, that fricative rhotics will vary in voicing, as most fricatives do (see Stevens et al. 1992; Ohala 1993), as well as in manner, as documented for other Spanish and Romance varieties.

4. Hypotheses

I hypothesize that conservative varieties, represented here by San Juan Spanish, will show a low level phonetic variation in the periodicity dimension both for palatals and for rhotics. However, I predict that in these varieties palatals and rhotics will differ more than in innovative varieties. In particular, it is expected that palatals should be higher in periodicity, and thus show a higher percentage of voicing, a small consonant-vowel intensity ratio and higher cepstral peak amplitude values, while the converse should be true for rhotics. On the other hand, innovative varieties, where the change is in progress (i.e. Corrientes Spanish), should be characterized by an increase of assibilation in palatals and a decrease of assibilation in rhotics. Finally, I hypothesize that these asymmetric patterns of assibilation are motivated in part[4] by the acoustic similarity (in periodicity and in place of articulation) between assibilated post-alveolars and fricative trills. This similarity would lead to potential misparsing of the sounds in varieties with assibilated palatals and rhotics.

5. Methodology

The data for the present analysis come from fieldwork recordings collected by the author between

[3] I will assume, following Martínez Celdrán (2004: 208), that an approximant is the result of (i) a lack of the articulatory precision required to produce a fricative; (ii) an insufficiently narrow constriction; (iii) a combination of (i) and (ii).
[4] I have argued elsewhere (Colantoni 2005) that social factors such as contact with Buenos Aires Spanish, a variety with assibilated palatals and trills, also play a role in triggering this change.

1994 and 1997 for the linguistic-anthropologic atlas of Argentina, a project directed by O. Kovacci. Interviews were conducted using a traditional dialectological questionnaire[5] supplemented by narratives elicited with sociolinguistic techniques.[6] Recording took place in a quiet place, using a tape-recorder with metallic tape and a unidirectional lavaliere microphone.

For the aforementioned project, a total of forty locations in the provinces of Corrientes (26), San Juan (19), Misiones (2) and Entre Rios (3) were surveyed. Only eight of those locations were selected here based on the results of either my previous studies (Colantoni 2001; 2005; 2006) or other studies on Argentine Spanish (Vidal de Battini 1955; 1964). The criterion for this selection was to analyze data representative of different stages in the process of loss of assibilation in rhotics and assibilation in palatals, ranging from areas with maintenance of assibilated rhotics (with a preference for voiceless variants) and approximant palatals in the western province of San Juan (Jachal –JCH-, Rodeo –RO-, Valle Fértil –VF-, Villa Krause – VK-) to locations with deassibilation in rhotics and increasing assibilation in palatals (Alvear –AL-, Bella Vista –BV-, Paso de los Libres –PL-, San Miguel – SM-) in the northeastern province of Corrientes. It is important to point out here that the selection of the locations was based on previous auditory analyses that were corroborated through the acoustic study of a small set of tokens. The speech of the eight male speakers[7] representative of those locations is analyzed here. The speakers were recruited following the general directions of the project; namely, they were native and lifelong residents of the locations under study, with no secondary education and ranging in age between 25 and 55.

In order to perform the analysis, tapes were digitized at 44100Hz/16-bit and then downsampled at 22050 Hz/16-bit. Words containing the target sounds[8] were extracted from the approximately two-hour long interviews. For rhotics, a total of 789 tokens were obtained, and 690 were acoustically analyzed after excluding 99 tokens for recording quality. As for palatals, 486 tokens were obtained, and only 293 were analyzed, since some tokens had to be excluded for quality reasons. Each token was coded for linguistic (stress, following and preceding segments), [9] and extra-linguistic variables (location). Results were exported to Excel, and statistics were calculated with SAS 8.02 (significance set at 0.05). All statistics, unless indicated otherwise, are the result of ANOVAs followed by post-hoc Fisher's LSD tests. For rhotics, statistics were only performed on a subset of the data analyzed (N= 532), in an attempt to have a comparable number of tokens per speaker, including a similar number of tokens in each of the cells relevant for the analysis.

To test the hypotheses, five different measurements were taken. First, the duration[10] of the target segments was analyzed, in order to be able (i) to determine the percentage of the duration of the segment that was voiced; (ii) to be able to center the window to analyze the four spectral moments (see below). Duration was measured using both the waveform and the spectrogram with Praat 4.0.41. The onset of the segment was determined by a change in the waveform, a drop in intensity, and a drop in F1, whereas the offset was set at the point where a change in the waveform, an increase in intensity, and an increase in F1 were observed. All measurements were taken at zero crossings. Secondly, the percentage of voicing (i.e. the duration of the F0 as a proportion of the duration of the whole segment) was measured. These values, which are expressed in percent of voicing, were obtained with Praat 4.0.41; and results were verified with Anagraf 2.0 (Gurlekian 1997), given that this program uses three

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[5] This questionnaire aimed at eliciting isolated words organized in several semantic fields, such as body parts, tools, plants, animals, etc.

[6] The narratives elicited included the description of local legends and important events, such as the 1977 earthquake in San Juan.

[7] Only male speakers were selected in order to facilitate the comparison with existing studies on post-alveolar sibilants.

[8] Only rhotics in singleton onsets word-initially and word-medially were analyzed here, since they are the only ones that can be compared with post-alveolar sibilants, given their distributional properties. Thus, the realization of rhotics in clusters in words such as *otro* 'other' is excluded from the present analysis.

[9] The role of these linguistic variables will not be explored in the present paper for two reasons: (i) given space constraints, I am focusing only on variables that will directly test the general hypotheses; (ii) it would be difficult to run statistics for palatals, given the small number of tokens obtained.

[10] Duration measurements will not be discussed here, since they do not directly test any of the hypotheses presented in §4.

different methods for calculating the F0. Thirdly, the consonant-vowel intensity ratio was calculated. If the segment is more periodic, and/or more approximant-like, a smaller ratio is expected. On the other hand, if the segment is more consonant-like a higher ratio should be obtained. Thus, to calculate the ratio the overall intensity of both the consonant and the following vowel was measured. Forth, in order to determine the degree of periodicity of the target segment, the cepstral peak amplitude was analyzed for all tokens. This method has been applied to determine the periodicity of Buenos Aires Spanish consonants and vowels (Santagada & Gurlekian 1989; Gurlekian et al. 1989), providing thus a useful source of comparison. Cepstral peak values were calculated over a 25ms window, centered at the center of the sound using Anagraf 2.0. A high peak-amplitude (values closer to 1) signals the presence of a periodic component; whereas lower values suggest the existence of noise in the signal. Finally, for those tokens whose cepstral peak values were lower than those reported for trills in Buenos Aires Spanish and identical or lower than those observed for post-alveolar sibilants in the same variety (i.e. ≤ 0.08), the center of gravity (first spectral moment) was calculated. Two reasons motivated this decision; first, moment analysis has been proposed as a method of classifying obstruents (Forrest et al. 1988), and consequently all segments that exhibited cepstral values above those reported for obstruents had to be excluded from the analysis. Second, in order to test the third hypothesis, namely, that there is an acoustic similarity between the existing assibilated rhotics and the new post-alveolar sibilants, it is important to verify that the comparison relies on segments with similar degrees of periodicity before testing their similarity in place. In order to perform the moment analysis, a 40ms Hamming window was extracted from the midpoint of the segment following procedures established in previous studies on fricatives (Evers et al. 1998; Flipsen Jr et al. 1999; Jongman et al. 2000); then a 512-FFT spectrum was obtained, and finally the four moments were measured with Praat 4.0.41.[11] In the next section, the results of these measurements will be discussed, with a special emphasis on the periodicity analysis.

6. Results

6.1 Cepstral peak amplitude

The cepstral peak amplitude (CPA) is the measurement of periodicity chosen here to test the first hypothesis, i.e. that palatals and rhotics in conservative varieties will differ more in the periodicity dimension than in innovative varieties. As shown in Figure 1, palatals are significantly higher in periodicity ($F_{(7, 293)} = 7.13$; $p < 0.0001$) in San Juan than in Corrientes, whereas rhotics exhibit the opposite pattern, namely, periodicity is higher in Corrientes than in San Juan ($F_{(7, 532)} = 13.13$; $p < 0.0001$).

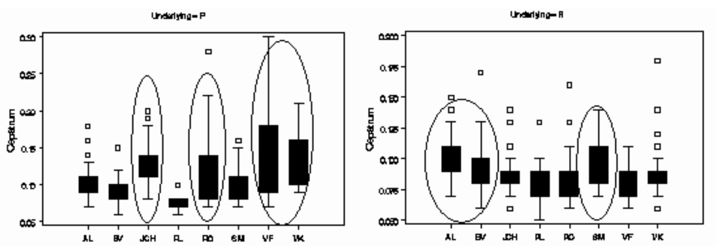

Figure 1: Box-plots of the cepstral peak amplitude for palatals (left) and rhotics (right). Ellipses indicate locations where the CPA is significantly higher.

Individual results (see Appendix 1) indicate that all four speakers in San Juan have palatals and rhotics that differ significantly in periodicity, whereas all speakers in Corrientes show no significant differences in this dimension. Finally, Figure 2 compares the range of CPA values for palatals and rhotics for all speakers, and several clear tendencies emerge. First, rhotics are the sounds with the lowest CPA for all eight speakers. However, for three Corrientes Spanish speakers (AL, BV and SM)

[11] As we will see in §6, very few post-alveolars met these requirements. Thus, even though the four moments were measured, only the results of the first moment or center of gravity will be discussed here, in order to develop new hypotheses for future studies.

CPA values for rhotics are not lower than for palatals. Second, for six speakers palatals are the sounds with the highest periodicity level, and for some speakers (e.g. RO and VF) their values are vowel-like (see Gurlekian et al. 1989). Third, there is a considerable overlap in values for palatals and rhotics in the lower range of the scale for all speakers, but this tendency is stronger for speakers from innovative varieties, such as PL, AL, BV and SM.

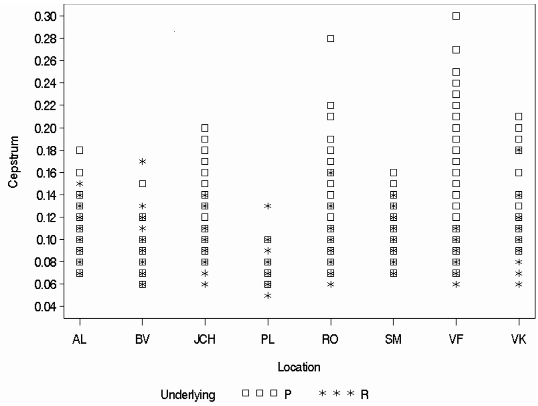

Figure 2: Scatter plot of CPA values in palatals and rhotics (all speakers)

6.2 Voicing

Voicing results are consistent with those obtained in the previous section (see Figure 3). Palatals tend to be significantly more voiced in the four locations in San Juan, than in three of the locations in Corrientes ($F_{(7, 293)} = 8.76$; $p < 0.0001$), with values approaching 100% voicing. More importantly, in these same locations (with the exception of Rodeo) rhotics are significantly devoiced ($F_{(7, 532)}$ = 35-52; $p < 0.0001$), with rates falling below 50%. Appendix 1 shows that palatals and rhotics differ significantly in the percentage of voicing in San Juan, whereas no significant difference was found in Corrientes.

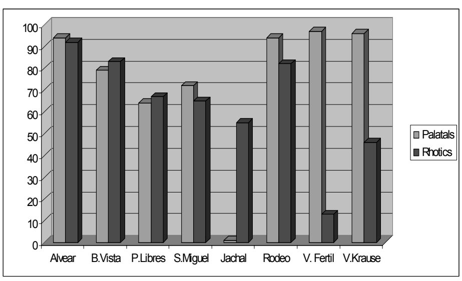

Figure 3: Percentage of voicing for palatals and rhotics (all speakers)

6.3 Consonant-vowel intensity ratio

If in the varieties under study palatals are becoming more consonant-like, then the CV intensity ratio should be larger. Figure 4 shows that for three out of the four participants from Corrientes this is the case; whereas for all four participants in San Juan the CV intensity ratio is significantly smaller, indicating a more vowel-like articulation ($F_{(7, 293)} = 6.31$; $p < 0.0001$). Rhotics, on the other hand, display a significantly larger CV intensity ratio in all locations in San Juan ($F_{(7, 532)} = 10.8$; $p < 0.0001$), signaling a more constricted articulation.

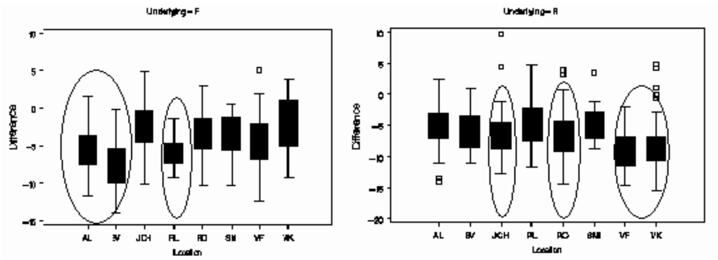

Figure 4: Box-plots of the CV-intensity ratio for palatals (left) and rhotics (right). Ellipses indicate locations where CV intensity ratio is significantly larger.

Appendix 1 displays the mean and standard deviation for each of the participants, confirming the results shown in Figure 4. Speakers from San Juan have the greatest difference in the CV intensity ratio when palatals and rhotics are compared. For these speakers, palatals have a small CV intensity ratio, which indicates a more vowel-like articulation. Rhotics, instead, are more fricative-like, which is shown by the larger CV intensity difference. Conversely, palatals and rhotics in Corrientes show similar values, suggesting that these segments are more similar in manner, when compared to those analyzed in San Juan.

6.4 Center of gravity

A similarity in periodicity is an indicator of similarity in manner and voicing, but, in order to determine the potential confusability of the existing rhotics and the new assibilated post-alveolars, it is necessary to explore whether they are also similar in place. In order to do that, the center of gravity was determined for all those segments (palatals and rhotics) whose periodicity was equal or lower than the one determined for Buenos Aires post-alveolar sibilants (see Santagada & Gurlekian 1989). As shown in Appendix 2, the main problem in testing the similarity in place between these two sets of sounds was the low number of palatal tokens that met the conditions stated above. If we focus only on the four speakers (RO, VF, PL and SM) that produced more than ten tokens,[12] several preliminary generalizations can be forwarded. First, there are no locations where either palatals or rhotics have values similar to those reported for English post-alveolar sibilants (see Table 1). Second, in the two locations in San Juan, the center of gravity is lower for palatals than for rhotics, suggesting a segment articulated further back in the oral cavity. On the other hand, PL's values for palatals and rhotics are similar, suggesting that palatals and rhotics with a comparable degree of periodicity are similar in place as well. However, recall from §2 that we are using values for English post-alveolar sibilants as a reference point, since there are no similar studies on Spanish. As such, it is difficult to determine with the present data whether the differences observed can be attributed to a difference in place or to the fact that we are comparing two languages and data obtained in different settings (i.e. fieldwork vs. laboratory). Given the methodological constraints, these results are only tentative. Stronger conclusions could be reached by (i) adding more data from neighboring towns; and (ii) analyzing fieldwork data obtained for both Buenos Aires Spanish and central Argentine Spanish (e.g. Córdoba), where assibilated palatals have been documented since the beginning of the 19th century (Vidal de Battini 1964).

6.5 Summary

Of the four dimensions analyzed here, three of them (CPA, voicing and CV intensity ratio) allow for a consistent comparison of palatals and rhotics in conservative and innovative varieties. Results for the CPA indicate that palatals display higher periodicity values in the four locations in San Juan than in Corrientes, suggesting a more vowel-like articulation in the former. Rhotics, on the other hand, are more periodic in Corrientes than in San Juan, with values close to the ones reported for trills in Buenos

[12] Note the different relative frequency of these palatals in their speech.

Aires Spanish (Santagada & Gurlekian 1989; Gurlekian et al. 1989). Results on the rate of voicing parallel those reported for the CPA; namely palatals tend to be fully voiced in San Juan, and rhotics exhibit higher rates of voicing in Corrientes. Finally, CV intensity ratio values suggest that palatals are more vowel-like in San Juan than in Corrientes, whereas rhotics are more obstruent-like in San Juan than in Corrientes. The remaining parameter (center of gravity) displays less consistent results, since it was only calculated for a small set of palatal tokens. The speaker (PL) with the highest center of gravity for palatals still exhibits lower values than those reported for English post-alveolar sibilants (see Jongman et al. 2000). For this speaker only, palatals and rhotics have a similar center of gravity. However, the values obtained seem to suggest that palatals are articulated further back than in Buenos Aires Spanish. Again, recall that this observation is only valid, if we assume that Buenos Aires post-alveolars are similar to their English counterpart.

7. Hypothesis evaluation and discussion

The first hypothesis, namely that palatals and rhotics differ more in periodicity in conservative varieties than in innovative ones, is confirmed by the results. In San Juan, all speakers have palatals with high CPA values, low CV intensity ratio and quasi-categorically voiced, suggesting the presence of an approximant-like segment. On the other hand, rhotics produced by these same speakers have low CPA values, higher CV intensity ratio and are devoiced, with values in the range of sibilant fricatives for the first two parameters.

The second hypothesis, i.e. that innovative varieties exhibit an increasing degree of periodicity in palatals accompanied by a decreasing degree of periodicity in rhotics, is partially confirmed by the results. Palatals produced by all speakers from Corrientes exhibit indeed higher CV intensity ratios and lower mean CPA values than those found in San Juan, but very few of these tokens are in the range of the CPA values reported for Buenos Aires post-alveolar sibilants. Rhotics, on the other hand, show signs of loss of assibilation, with CPA values in the range of trills, a high rate of voicing and a low CV intensity ratio.

The third hypothesis is also partially confirmed. CPA values for palatals are lower in Corrientes than in San Juan, which is consistent with a strengthening process. However, these values are not systematically lower than those obtained for assibilated rhotics in San Juan, with the only exception of PL (see Figure 2). This difference in periodicity is validated by the intensity results, which indicate that rhotics in San Juan have a more constricted articulation than palatals in Corrientes. However, an analysis of individual speakers, such as PL, reveals that his palatals and rhotics are similar in three dimensions: CPA, CV intensity ratio and center of gravity, indicating a similar constriction degree as well as a similarity in place of articulation. Thus, a comparison of post-alveolars sibilants and fricative trills shows that assibilated and non-assibilated variants display a complementary distribution geographically; namely, varieties with approximant palatals tend to have fricative rhotics, whereas varieties with fricative palatals (including sibilants) tend to have more approximant-like rhotics. Acoustically, assibilated palatals and rhotics are similar in their degree of periodicity (low), although palatals in the varieties under study are still more periodic than rhotics.

As concerns palatals in particular, it is important to point out that results reveal that conservative varieties have a preference for approximants rather than fricatives, which have been reported for other dialects (Navarro Tomás 1970; Quilis 1993). This claim is supported by the high CPA values and the low CV intensity ratio found here. Indeed, two speakers (JCH and VK) have a lower CV intensity ratio than the one reported for English glides (Balakrishnan et al. 1996). On the other hand, the new palatals differ from Buenos Aires post-alveolars in their higher CPA and in the preference for fully voiced variants. The variation between approximants and non-sibilant fricatives attested for all speakers could be classified as a micro or 'hidden variation' (see Ohala 1989), since it is consistent with a similar pattern reported for glides in Spanish and other languages. Thus, it could be hypothesized that such variation is below the level of awareness of these Spanish speakers. Instead, the emergence of post-alveolar sibilants, which result from a further narrowing in the constriction, could be analyzed as a case of macro variation. Macro variation is interpreted here as a variation that is perceptually salient (Ohala & Kawasaki 1984: 116) to the speakers of a given variety. Although there is no direct evidence of native speakers' awareness of assibilation in palatals, linguists have reported a similar change in other Argentine Spanish varieties (e.g. Coronel 1995). This extension of assibilation has been attributed to the influence of Buenos Aires Spanish (e.g. Coronel 1995; Colantoni 2001), where post-alveolar sibilants are the only variants used. Crucially, all Argentineans have been exposed to the variety spoken in the capital, either through the media or contact with its speakers. Thus, it is expected that an increase in the use of these more constricted variants will be eventually perceived by L1 learners (and probably by some other speakers in the community as well), introduced in their repertoires, eventually substituting the non-assibilated palatals.

Finally, rhotics are part of a continuum that ranges from sibilant fricatives to approximants, with a preference for the former in conservative varieties and a higher frequency of the latter in innovative varieties. In one of the extremes of the continuum, assibilated rhotics are similar to Buenos Aires Spanish post-alveolars in their CPA values (see Gurlekian et al. 1989). In the other extreme of the continuum, approximant rhotics are similar in periodicity to Buenos Aires trills, albeit different in manner. However, whereas narrowing of the constriction in palatals would lead to an increase in frication and the emergence of an assibilated allophone, a change in the constriction degree would not yield the production of a trill but the emergence of an approximant variant. This is indeed what we observe in Corrientes. The variant produced by some of the speakers is similar in periodicity to Buenos Aires trills (see Gurlekian et al. 1989); however, it differs from the trill articulatorily. Moreover, there is some evidence that this approximant variant may be perceived as a trill (Colantoni 2005b). Indeed, approximants and trills alternate in several Spanish varieties (Hammond 1999; Blecua 2001), and listeners do not seem to be aware of this alternation. Thus, the seed of this change may be in micro phonetic variation between voiceless and voiced assibilated rhotics (Quilis & Carril, 1971). If voicing increases and friction decreases, this micro variation will eventually lead to the emergence of the percept of a new rhotic variant. Such a change, which would constitute a case of macro variation, has already been observed by Vidal de Battini (1955) in the speech of the educated classes of assibilating varieties in Northern Argentina. However, further research is needed to determine whether there is a periodicity threshold both for palatals and for rhotics, and, moreover, whether the new approximant rhotics are indistinguishable from trills.

So far, I have focused on the phonetic mechanism that may have triggered the variation pattern observed in different areas of Argentina. What remains to be accounted for is how new variants would emerge in the speech community.

8. Emergence of new variants over time

Variation in the signal is a pre-condition for sound change (Ohala 1989). Results presented here show that in the periodicity dimension all speakers have tokens of both palatals and rhotics that are low and high in periodicity. They differ, however, in the frequency of tokens that can be characterized as assibilated or non-assibilated, as well as in the range of the periodicity scale used in their speech. For instance, although AL has rhotics that are low in periodicity in his repertoire (CPA = 0.07 ~ 0.08), as VF does, most of his rhotics (77%) are higher in the periodicity scale (see Appendix 2). VF's rhotics, on the other hand, are concentrated in a narrower range in the lower frequencies. Since all speakers produce palatals and rhotics that vary in their degree of periodicity, it could be hypothesized that learners exposed to their speech would become familiar with different realizations of one phonological form. Thus, in Blevins' terms (2004:32), these learners would be facing a case of 'choice', i.e. of multiple phonetic realizations of a single phonological form. It is possible, thus, that in the acquisition process these speakers will postulate an underlying representation that differs from the one of the previous generation. This is more likely to happen to listeners that are exposed to the speech of AL, BV or SM (see Figure 2), who have tokens of both palatals and rhotics evenly covering the same range of periodicity values.

A second mechanism could trigger the emergence of new allophones as well, namely what Blevins calls 'chance' (2004:32). According to Blevins, phonological ambiguity is a source of sound change. Thus, when a listener is exposed to an ambiguous sequence, s/he may postulate an analysis that differs from the speaker's analysis. A study of the range of CPA values produced by all speakers and a comparison of the degree of overlap reveals that for speakers AL, BV, SM and PL there is a greater degree of overlap than for JCH, RO, VF and VK, whose rhotics tend to concentrate in the lower scale, and whose palatals are higher in periodicity (see Figure 2). If in addition to similarity in periodicity, there is similarity in place, as in the case of PL (see §6.4), it may be hypothesized that in the acquisition process as well as in daily interactions there would be a greater chance of misinterpreting this speaker's palatals as rhotics (or vice versa). As such, a listener may deduct that two assibilated sounds that PL produced in a sequence cannot be indeed two assibilated variants but one, and as such, re-interpret one of the assibilated sounds as a non-assibilated one. Over time, this would lead to loss of assibilation either in palatals or in rhotics. As for which one would be deassibilated first, it is expected that both type and token frequency will play a role (see Colantoni 2001, 2005).

Finally, it is also possible to imagine a system with the existing assibilated rhotics and the new assibilated post-alveolars. Such systems are attested in other Spanish varieties (see Argüello 1978; Lipski 1994: 248), and in other languages (see Dankovičová 1999 for Czech). However, this alternative (i) is not consistent with the results observed; and (ii) would ignore the fact that other variety, such as Buenos Aires Spanish, is playing a role in triggering these changes (Colantoni 2005).

The hypotheses forwarded here are restricted by the small sample analyzed and, in particular, by the small number of palatal tokens obtained, which did not allow us to explore the role of the phonetic environment in the production of assibilated vs. non assibilated forms. However, the fact that there is variation in the speech of individuals and that this variation exhibits different patterns in different areas allows us to start articulating more solid and testable hypotheses about the direction of a frequent type of sound change in Spanish.

Appendix 1: Cepstral peak values, CV-intensity ratio, and voicing: palatals and rhotics (all speakers) [13]

Location	CPA value				CV intensity ratio (dB)				Voicing (%)			
	Palatals		Rhotics		Palatals		Rhotics		Palatals		Rhotics	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AL	0.10	0.02	0.09	0.01	-5.4	3.5	-5.5	3.1	94	22	92	18
BV	0.09	0.02	0.09	0.01	-7.5	4.4	-5.7	2.9	79	25	83	31
PL	0.07	0.01	0.08	0.01	-5.6	2.2	-4.6	3.5	64	44	67	36
SM	0.10	0.02	0.09	0.02	-3.7	2.8	-4.7	2.9	72	43	65	39
JCH	0.13*	0.03	0.08*	0.01	-2.5*	2.9	-6.3*	3.8	1*	0	55*	44
RO	0.11*	0.04	0.08*	0.01	-3.7*	2.8	-6.7*	3.8	94*	18	82*	39
VF	0.13*	0.05	0.08*	0.01	-4.6*	3.2	-9.1*	3.2	97*	13	13*	24
VK	0.13*	0.03	0.08*	0.01	-2.3*	3.5	-8.1*	3.8	96*	19	46*	40

[13] Here and in Appendix 2, the '*' indicates a statistically significant difference (results of post-hoc Fisher's LSD tests) between the values for palatals and rhotics.

Appendix 2: Center of gravity and duration values: palatals and rhotics (all speakers)

Province	Location	Center of gravity (Hz)						Duration (ms)			
		Palatals			Rhotics			Palatals		Rhotics	
		N	Freq.	Mean	N	Freq.	Mean	Mean	SD	Mean	SD
Corrientes	AL	4	0.14	1627	19	0.23	1165	70	27	66	16
	BV	4	0.44	1705	19	0.28	1599	83*	36	62*	13
	PL	13	0.92	2408	55	0.96	2288	73	12	77	17
	SM	10	0.30	1392	9	0.35	1202	63	19	61	15
San Juan	JCH	2	0.04	785*	38	0.53	2656*	60*	17	69*	14
	RO	18	0.26	1110*	48	0.57	2217*	65	15	63	11
	VF	11	0.17	1366*	42	0.66	2989*	69*	19	97*	27
	VK	0	0	n/a	34	0.47	2856	71	15	78	22

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