

# FROM POSTASPIRATION TO AFFRICATION: NEW PHONETIC CONTEXTS IN WESTERN ANDALUSIAN SPANISH

María Del Saz

Universidad de Santiago de Chile  
maria.delsaz@usach.cl

## ABSTRACT

Western Andalusian Spanish is one of the many coda /s/ weakening varieties of Spanish in the world. It is documented that there is a growing tendency for speakers of this variety to realize /st/ clusters not only with postaspiration (*pasta* [páʃ<sup>h</sup>a]) rather than preaspiration (*pasta* [páʃ<sup>h</sup>ta]), but also with affrication (*pasta* [páʃ<sup>s</sup>a]). In this study, we present evidence of postaspiration and affrication beyond /st/ clusters, i.e., also in stop + /t/ clusters, as detected auditorily in recorded background interviews with Western Andalusian Spanish speakers. Further acoustic analyses of duration, zero crossing rate, and center of gravity of the friction segment in the tokens corroborated the existence of postaspiration and affrication in both contexts. However, while postaspirated tokens were similar in all parameters for both /st/ and /Ct/ clusters, affricated tokens presented higher frequency and concentration of energy in /Ct/ clusters. Further research into these emerging phenomena seems to be needed.

**Keywords:** Western Andalusian Spanish, aspiration, affrication, phonetic change

## 1. INTRODUCTION

Andalusian Spanish varieties (Eastern and Western) are characterized by the predominant weakening of coda /s/. In terms of articulation, Andalusian /s/ is described as predorse-dentoalveolar [s̺], while mainstream Castilian /s/ is apico-alveolar [s]. The former is articulated with very little movement of the tongue tip, horizontally and vertically, and at a much lower rate than the latter [1]. In fact, “one could speculate that a predorse-dentoalveolar /s/ is not, in evolutionary terms, what could be considered a ‘good’ /s/ and is, consequently, likely to be weakened” (p. 205). Concerning coda /s/ weakening, a particular characteristic unique to Western Andalusian Spanish is that coda /s/ before voiceless stops /p, t, k/, word-internally and across word boundaries, is mainly realized as postaspiration [p<sup>h</sup>, t<sup>h</sup>, k<sup>h</sup>] rather than preaspiration [hp, ht, hk], giving way to stops with longer VOTs than in other varieties of Spanish [2][3].

Explanations for postaspiration include opposing views. On the one hand, one view [2] proposes a gestural reorganization in which the glottal opening for the aspirated /s/ and the supraglottal closure for the following stop overlap instead of being sequential, as is the case with dialects with preaspiration. In this case there would be a direct relationship between stop closure length and the presence of either preaspiration or postaspiration in the clusters. On the other hand, another view [4] considers a phonological reanalysis, with postaspirated stops as part of a new set of phonemes in Western Andalusian Spanish, working in opposition to their unaspirated counterparts. Instead of being the result of an overlap of gestures, this set of sounds would be considered target categories and not the result of coarticulatory gestures, especially when the overall duration of postaspirated stops is actually shorter than sequences that present preaspiration [5]. So far, the question of “whether this reduction is an online phonetic process or a phonological one has not been thoroughly investigated” [6, p. 37], although it seems to be conditioned by lexical frequency and phonetic context, with a higher incidence before the high front vowel /i/, especially in less frequent words [7].

Additionally, the case of /st/ clusters has received special attention given that a new phenomenon has emerged among the younger population (< 35 years old) in the area, by which postaspirated [t<sup>h</sup>] is increasingly realized as an affricated [t<sup>s</sup>] [8] [9] [10]. In her study of these clusters, Ruch [11] determined seven possible realizations of the sequence /s/ + /t/ in Seville (Spain): sibilance [st], pre-aspiration [ht], pre and post-aspiration [hth], post-aspiration [t<sup>h</sup>], gemination [t:], elision [t], and affrication [t<sup>s</sup>]. For this /s/ + /t/ sequence in Málaga, Vida Castro [9] [10] proposes five solutions: [st], [ht], [th], [t:], [ts]. Both authors agree that the most common by far are postaspiration and affrication [9] [10] [11].

Concerning this ongoing phonetic change from postaspiration to affrication, a current explanation so far is consistent with a view of realignment of gestural timing and assume a metathesis [12] as the result of a process of resyllabification of /s/ from a coda to an onset position, in an attempt from speakers to recover the sibilant as a sign of prestige [9] [10]. On the contrary, under the view of a

phonological reanalysis, the explanation for affrication is that the segment undergoes a process of fortition [5].

Amid the debate on /st/ clusters, this study offers evidence of the incidence of postaspiration and affrication in other phonetic contexts (stop + /t/), as found in words extracted from recorded interviews with native speakers of Western Andalusian Spanish, by means of the analysis of duration, zero crossing rate (\*10/interval duration), and center of gravity (CoG) of the key segments.

## 2. METHOD

### 2.1. Participants

Thirty-three speakers of Western Andalusian Spanish (age range 19-33;  $M_{age} = 22.08$ ) from different towns in Seville, Cadiz, Huelva, and Malaga participated in this project carried out at the Universidad de Sevilla. Participants signed informed consent forms and filled out background questionnaires prior to the recordings. From the 33 informants that volunteered to participate, 3 were eliminated because they spent their childhood outside the western area of Andalusia, which was reflected in their speech.

### 2.2. Materials

The instruments for the recordings were part of another research project that consisted of three parts. First, semi-guided background interviews were conducted, in which participants were asked about their current studies and projections for the future, as well as other topics that came up naturally during the interviews. Second, a number of sentences were presented with selected keywords and colloquial tags to elicit natural speaking. Third, a number of words were presented by means of a timed PowerPoint presentation. For this communication, only the findings from the interviews are reported, where we found the phenomena analyzed in this paper. Thus, word accentuation or frequency was not controlled for.

### 2.3. Procedure

The recordings were conducted in a soundproof booth at the Phonetics Laboratory of the Universidad de Sevilla (Spain), under the supervision of the experimenter, with a Zoom H6 portable recorder at 44,100 Hz and 16 bps sampling rate, in .WAV format. Each file was first processed auditorily to select key words containing postaspiration [ $t^h$ ] and affrication [ $t^s$ ] in consonant + /t/ contexts. Once tokens were extracted and labelled, the fricative

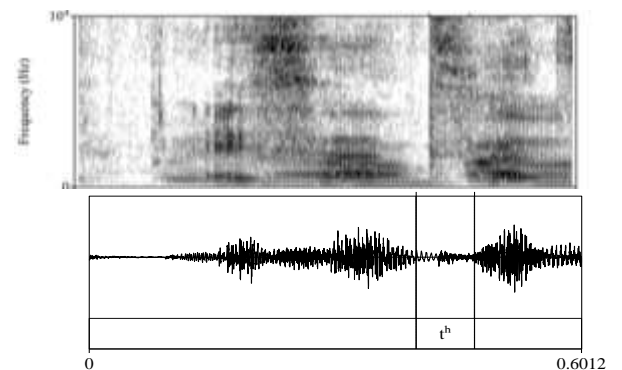
portions of the target words were tagged using Praat [13], from the beginning of the stop burst to the beginning of periodicity of the following vowel, and subsequently analyzed for duration (ms), zero crossing rate (\*10/interval duration), and CoG (Hz) using a Praat script designed for the purpose [14]. Mixed models were then performed to compare targets [ $t^h$ ] and [ $t^s$ ] between phonetic contexts (/st/ and /Ct/). Based on the auditory selection of words, we expected to find instances of both postaspiration and affrication in /Ct/ clusters.

## 3. RESULTS

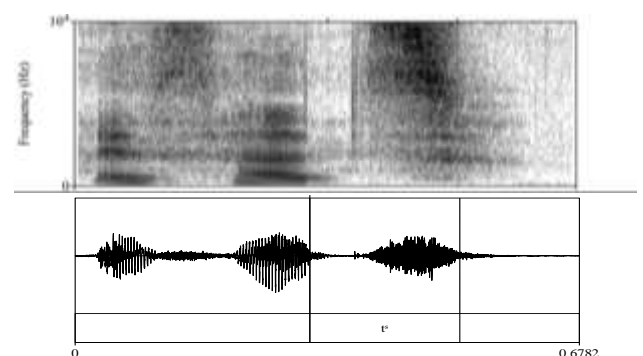
Out of the 489 words selected and analyzed (see Appendix), 441 (90.18%) were /st/ clusters. In this context, 26.08% of the tokens presented postaspiration, while 73.92% of them were realized with affrication. From the rest of the contexts (9.82%), we found that 85.42% of the cases were /kt/ clusters, 10.42% were /pt/ clusters, and finally, 4.17% were /bt/ clusters. Out of these 48 tokens, 33.33% presented postaspiration, and 66.67% were realized with affrication.

Figures 1 and 2 show spectrograms and oscillograms of [ $t^h$ ] and [ $t^s$ ] in the word *exacto* (exact) from two different female speakers, with CoGs of 1.66kHz and 10kHz respectively:

**Figure 1:** Spectrogram and waveform of aspiration in the word *exacto*



**Figure 2:** Spectrogram and waveform of affrication in the word *exacto*



Tokens that presented a CoG lower than 4kHz were easily identified as [t<sup>h</sup>], the lowest one with 315Hz, while those that presented a CoG higher than 6kHz were easily identified as [t<sup>s</sup>], with some examples reaching as high as 10kHz-11kHz. Tokens found in the range of 4kHz-6kHz presented variation in perception, which can account for the ongoing process, although the majority of them was identified as affrication.

The results of the measurements are presented in the three tables below. In terms of duration (Table 1), the affricated variety is longer than the postaspirated one in both contexts. Individual comparisons across contexts (context\*target) revealed no differences in duration for either [t<sup>h</sup>] or [t<sup>s</sup>] tokens ( $F$ -value = 1.7496;  $num\ df = 1$ ;  $denom\ df = 57.4$ ;  $p = 0.191$ ).

**Table 1:** Duration (ms), SE, and CI of aspiration and affrication in /st/ and /Ct/ clusters.

	/st/	/Ct/
[t <sup>h</sup> ]	53.357 (2.0081) [49.380-57.334]	46.045 (6.068) [33.858-58.232]
[t <sup>s</sup> ]	60.378 (1.3820) [57.599-63.158]	63.204 (4.383) [54.409-72.000]

Zero crossings rate (ZCR) refers to the number of times that the amplitude of the speech signal passes through a value of zero within a given interval, and is indicative of frequency and also voice. Results show (Table 2) that ZCR is higher for affrication than for postaspiration in both contexts, which points at the existence of such phenomena in clusters other than /st/. Nevertheless, ZCR in the affricated tokens was significantly higher in /Ct/ contexts than in /st/ clusters ( $F$ -value = 14.560;  $num\ df = 1$ ;  $denom\ df = 60.9$ ;  $p = 0.0006$ ), providing evidence of greater frequency in this type of sequences.

**Table 2:** ZCR, SE, and CI of aspiration and affrication in /st/ and /Ct/ clusters.

	/st/	/Ct/
[t <sup>h</sup> ]	87.914 (2.804) [82.358-93.469]	81.990 (7.649) [66.648-97.332]
[t <sup>s</sup> ]	123.915 (2.089) [119.710-128.120]	145.282 (5.596) [134.075-156.488]

In relation the CoG, i.e. the frequencies at which a higher concentration of energy is present, postaspirated tokens present a clearly lower CoG than affricated ones in both contexts (Table 3), which again seems to indicate that both phenomena are present in both contexts. However, while [t<sup>h</sup>] tokens present similar CoG in both contexts, [t<sup>s</sup>] is significantly higher in /Ct/ than in /st/ clusters ( $F$ -value = 6.752;  $num\ df = 1$ ;  $denom\ df = 63.7$ ;  $p = 0.023$ ), which points at a concentration of energy at higher frequency in this context.

**Table 3:** CoG (Hz), SE, and CI of aspiration and affrication in /st/ and /Ct/ clusters.

	/st/	/Ct/
[t <sup>h</sup> ]	4015.531 (173.9103) [3670.858-4360.204]	3220.5870 (428.8665) [2360.804-4080.370]
[t <sup>s</sup> ]	6827.310 (130.599) [6564.204-7090.416]	7646.886 (316.040) [7014.332-8279.441]

#### 4. DISCUSSION

The findings in this study seem to point at the existence of an ongoing phonetic change in Western Andalusian Spanish that extends beyond the /st/ clusters reported in several previous studies. While postaspiration and affrication are the common realizations of /st/ clusters among the younger population in this variety, we seem to have found evidence that other consonant + /t/ clusters can undergo the same processes (stops + /t/). Comparisons between both types of clusters revealed that postaspirated productions were similar in both contexts, whereas affricated productions in /Ct/ clusters presented higher ZCR and CoG than in /st/ clusters, i.e., higher frequency and concentration of energy.

Coda stops in word-medial position in Spanish are not common, although the most frequent one is /k/, which is consistent with the high number of examples of /kt/ sequences found in our interviews, as opposed to /pt/ and /bt/ sequences. For Eastern Andalusian Spanish (EAS), it has been established that obstruent codas are neutralized by preaspiration followed by the gemination of the following consonant [15] [16]. In this case, /st/, /kt/ and /pt/ clusters would be neutralized as [ht:]. However, one study on the perception of EAS neutralization in these clusters reports this neutralization to be incomplete, as /pt/ was distinguishable from /st/ and /kt/ in terms of longer closure duration. In light of

this, it may be that in Western Andalusian Spanish obstruent codas were also neutralized by means of aspiration, as a way to signal the underlying existence of a consonant, and are beginning to undergo the same processes as the more frequent /st/ clusters by phonetic analogy [17]. In this case, we would be in the presence of an ongoing phonetic change with lexical diffusion [18] extending from the most frequent phonetic context /kt/.

The phenomenon of affrication seems to be relatively established for /st/ clusters among the younger population, although it still remains to be determined how affrication emerged. Since this phenomenon has only been reported in /st/ clusters, one of the existing explanations is the resyllabification of /s/ from coda to onset position in attempt to recover the fricative as a sign of prestige pronunciation, giving place to metathesis. It may then be a matter of ease of articulation, by which the sequence /ts/ is easier to articulate than /st/, as /s/ becomes the release stage of the stop while maintaining the tendency to weaken the sibilant in coda positions. Under the view of a phonological reanalysis, the proposition is that [tʰ] has undergone a process of fortition, as reported in syllable-initial position for other languages such as English [19], in which the presence of /t/ is said to favor not only aspiration, but affrication as well. In fact, voiceless sibilant affricates (whether alveolar or dental) are found in quite a few languages, in which “the turbulence produced at plosive release, if elongated ... may end up producing a period of frication. In this respect, stop releases may provide good conditions for frication” [20, p. 312]. Indeed, the fact that Western Andalusian Spanish [tʰ] seems to be shorter than the preaspirated [htʰ] and affricate /tʃ/ [5] may indicate that it is uttered as a single voiceless sibilant affricate, although with no phonological value.

This ongoing change may have been triggered sporadically [6], by means of a combination of both production and perception [21],[22]. Ruch and Harrington [22] found that L1 Argentinian listeners, whose variety of Spanish uses preaspiration, perceived an underlying /s/ in Western Andalusian Spanish even when only a slight postaspiration was present in the stimuli. It may be that in certain phonetic contexts affrication is produced or perceived as such, and subsequent language use may be beginning to change the underlying representations of the speakers [18].

In any case, one of the informants we interviewed, who employed [tʰ] in all contexts reported here, made use of *ceceo* everywhere else. *Ceceo* is a characteristic by which a speaker makes an interdental realization of /s/ and thus substitutes

[θ] for [s]. In this case, both *casa* (house) and *caza* (hunting) are pronounced [káθa]. Therefore, this speaker never used /s/ under any circumstance except in her affricated realizations of /st/ and /Ct/ clusters.

## 5. CONCLUSIONS

In this study we showed evidence of the presence of postaspiration and affrication in phonetic contexts other than /st/ clusters in Western Andalusian Spanish, with similarities and differences between both. These findings warrant further investigation regarding the nature and the direction of this ongoing phonetic change, as well as the factors that promote it.

## 6. ACKNOWLEDGMENTS

I would like to thank Becas Santander para Jóvenes Profesores e Investigadores for the opportunity to carry out this research project. Special thanks to Christián Abello and Mary Hely Cuenca for their help with recruitment, and to Marina Barrio for her expertise in methods.

## 7. APPENDIX

List of words by phonetic context and target phenomenon.

/st/		/Ct/	
/tʰ/	/tʰ/	/tʰ/	/tʰ/
gusta 38	estoy 15	exacto 9	prácticas 4
estoy 30	gustaría 13	arquitectura 3	exacto 3
master 19	gusta 12	proyecto 2	atractiva
gustado 15	estudiar 8	prácticas 2	contacto
lingüística 14	estaba 6	obtener 2	doctorado
estudios 14	estudios 6	práctica 2	exactamente
estuve 11	gustaba 5	afecta	lectura
instituto 11	lingüística 5	aspecto	optativa
gustaría 11	master 5	dialecto	optativas
este 10	gustado 4	directamente	selectividad
gustaba 9	estar 3	practicar	septiembre
historia 9	este 3	selectividad	
estudiando 8	esto 3	sintácticos	
gustó 8	estuve 3	aceptado	
esto 6	esta 2	exactamente	
estudiar 5	gustan 2	lectura	
gustan 5	costado	optativas	
está 3	cuesta	proyectos	
puesto 3	distinta	optativas	
textos 3	estable	septiembre	
estudiado 2	estudio		
estudiantes 2	estudiado		
estudié 2	estudiando		
estudio 2	gestos		
estuvo 2	gustar		
gustando 2	gusten		
hasta 2	hasta		
magisterio 2	historia		
vista 2	instituto		
estado	lingüístico		
estudia	magisterio		

estudian	puesto
existía	sistema
gustaban	gusto
gustara	gustó
guste	visto
investiga	
investigando	
investigar	
investigación	
investigué	
lingüísticas	
lingüísticos	
listas	
orquesta	
resto	
sexto	
usted	
visto	
es todo	

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