Affrication of /st/-clusters in Western Andalusian Spanish: variation and change from a sociophonetic point of view

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Abstract

This study focuses on an apparently new sound in Seville Spanish. An affricated dentoalveolar stop [t^s] (*listo* [ˈlit^{s}o]) has been described as a variant of /st/-clusters. This sound is perceptually and acoustically similar to [t^h], another /st/-allophone in Seville Spanish. For the auditory distinction between [t^h] and [t^s], VOT-duration, proportion VOT/total duration and closure duration were significant. The value for center of gravity of [t^s] was similar to that in /s/. The frequency of occurrence of [t^s] was negatively correlated with age and speech formality level, and positively correlated with the level of education. The social distribution of [t^s] suggests a sound change in progress in Seville Spanish.

1. Introduction

Aspiration of syllable final /s/ is a common phenomenon in many varieties of Spanish. The so called *s-aspiration* can be found in the varieties of Cuba, Puerto Rico, Chile and the Canary Islands, to mention just a few examples. It has been described even for Madrid Spanish [1]. S-aspiration is usually realized as a voiceless glottal fricative [h], and in the following referred to as *preaspiration*. Accordingly, *listo* ('clever', 'ready'), Standard Spanish [ˈlisto] is pronounced as [ˈlihto].

There is considerable variation in the aspiration of syllable-final /s/, depending on the phonotactic context, dialect and social variables. Of particular interest among the aspirating dialects is Andalusian, which has been described as the most innovative variety of Spanish. This study focuses on /st/ clusters, as in this context there is a noticeable variation on different levels, i.e., not only on the phonetic-acoustic level, but also on the dialectological and sociolinguistic levels.

On the one hand, there are differences in the manner of aspiration between Eastern (e.g. Granada) and Western Andalusian Spanish (e.g. Seville), according to [2]. In Eastern Andalusian Spanish, /sp, st, sk/ clusters are usually realized with preaspiration [hp, ht, hk], whereas in Western Andalusian Spanish, postaspiration [p^h, t^h, k^h] is much more frequent, at least among younger speakers [2], [3], [4]. Phonetic studies on /sC/ clusters in Eastern Andalusian Spanish report for preaspiration, breathy voicing in the preceding vowel and geminates [5], [6], but not for postaspiration. Traditional dialectological studies as the *Atlas lingüístico y etnográfico de Andalucía* (ALEA) [7] also refer to geminates and aspiration, but the transcription modes of the latter (e.g., [kaˈnahta] standing for *canasta*, 'basket') clearly suggest that dialectologists did not distinguish between pre- and post-aspiration. These matters of fact suggest a sound change in progress from pre- to postaspiration in Western Andalusian Spanish: [hp, ht, hk] ⟶ [p^h, t^h, k^h]. In Western Andalusian

Spanish, there are other phonetic variants related to /s/-aspiration: an affricate [ts], [t^s] has been described as a variant of /st/-clusters (e.g., *listo* [ˈlit^{s}o]) for Seville and Antequera [8]. This dental or dentoalveolar affricate or affricated [t] is a new sound in Spanish, as the only affricate in modern Spanish is the palatal [tʃ] (*mucho* 'much', [ˈmutʃo]). To the best of our knowledge, the dentoalveolar affricate /st/-allophone has not been described in the traditional dialectological studies, which suggests a sound change from [t^h] ⟶ [t^s] – a further step in the context of change from pre- to postaspiration.

2. Hypothesis

The main focus of this study is the social distribution of the [t^s]-sound in the speech of Seville speakers. As a phonetic-acoustic description of this /st/-allophone has not been done yet, we dedicate a section to this issue as well. The new sound, denominated by [8] as a dental affricate, is auditively and acoustically very similar to [t^h]. Which acoustic cues are relevant for the auditory distinction between the aspirated and affricated /t/? How can we define the apparently new sound on a phonetic-acoustic level? We assume that the new /st/ allophone is an affricate and though in durational terms similar to Spanish [tʃ]. With respect to place of articulation, we suggest that [t^s] is dentoalveolar, as is the Spanish /t/ [9]. Accordingly, we expect [t^s] to have a higher center of gravity than [tʃ]. What social variables actually favour the occurrence of [t^s]? Does the frequency of the new sound depend on age, level of education and gender? What does the distribution of [t^s] according to different social variables tell us about the prestige of the new sound, what about its diffusion in the speech community of Seville? Following the apparent-time methodology, we hypothesize that the [t^s]-sound is more frequent in the speech of young people than in the speech of old speakers. Preliminary informal observations produced the impression that the affricated /t/ is not stigmatized, as it is produced not only by students, but even by lecturers in university classes. In this study, we intend to formally test the hypothesis of [t^s] as a prestigious or, at least, non-stigmatized sound. If the level of education has a positive effect on the occurrence of this variant, this hypothesis would be confirmed. Finally, according to previous observations we expect no influence of gender.

3. Methodology

3.1. Material

The speech of 53 subjects from Seville was analyzed. The group was balanced for the social variables of age, gender and educational level. Following current sociolinguistic methods, the interview protocol included a conversation with the

interviewer, the reading of a text and a word list in order to obtain different levels of formality. Out of this speech material we set up two corpora, one for the acoustic and one for the sociolinguistic analysis. The results reported on here concern only a subset of the data collected.

3.2. Analysis of acoustic parameters

The corpus of the acoustic study consisted of 120 /st/ realizations, both affricated and aspirated dentoalveolar stops, pronounced by three male speakers. At the moment of the recordings subject M19 was 18 years old, subject M51 was 29 and subject M78 was 39. For all three speakers, the /st/ tokens came from the reading and the last five minutes of the conversation. The examples included different types of lexical words. Both bisyllabic as well as polysyllabic words were included for all three speakers. The corpus included /st/ in different phonotactic (preceding and following vowel) and prosodic (lexical stress) contexts for every subject.

After a preliminary auditory classification, we analyzed the center of gravity of the release, the VOT duration and the closure duration; and the proportion VOT/total duration was then calculated. The measurements were done manually in Praat [10]. We then tested the statistic significance of the differences by means of an ANOVA pair-wise test, using the statistical software SPSS.

In addition, 30 palatal affricates (e.g. *chico* [ˈtʃiko], 'boy') were analyzed, in order to compare the [tˢ] allophone with the palatal phoneme. For each of the three speakers, 10 affricates were analyzed. Similarly to the /st/ allophones, they proceeded from the conversation and the reading parts of the interview, as well as from different prosodic and phonotactic contexts, in order to facilitate a comparison between [tˢ] and /tʃ/.

3.3. Analysis of social variables

For the sociolinguistic analyses, we worked with a corpus of 5437 /st/ tokens, pronounced by 53 Sevillian speakers. The /st/ allophones were classified into different categories, e.g. [st], [ht], [htʰ], [tʰ], [tˢ]. The classification of the /st/ allophones was carried out auditorily and by inspecting spectrograms and oscillograms. We then compared the occurrence of [tˢ] in the different formality degrees and tested for the influence of the social factors of gender, age and educational level. The statistical significance of the differences was proven by ANOVA tests. The distribution of the subjects among the different social variables is represented in Table 1.

4. Results

4.1. Acoustic parameters

Overall, the friction of [tˢ]-sounds presented a mean value for the center of gravity of 6902 Hz, similar to the center of gravity of [s] in [st], which was about 6500 Hz. VOT mean duration was 60.81 ms and closure duration 57.09 ms; the VOT/total duration ratio was of 0.52.

There were important differences among speakers, as shown in Table 2 and 3. As these differences could be due to speech rate, the ratio between VOT and total duration of /st/ was also calculated. Table 3 shows that there was important variation between and within speakers also for the proportional duration. Furthermore, some affricates and aspirated stops were preaspirated or exhibited a breathy voicing in the preceding vowel.

	Primary studies	Secondary studies	University degree
20-34 years	3 f., 3 m.	3 f., 3 m.	3 f., 3 m.
35-54 years	3 f., 3 m.	3 f., 3 m.	3 f., 3 m.
> 55 years	3 f., 3 m.	3 f., 3 m.	2 f., 3 m.

Table 1: *Age, gender and educational level of the 53 Sevillian speakers of the sociolinguistic study.*

Speaker	N	Mean clos dur (ms)	s.d.	Mean VOT dur (ms)	s.d.
M19	26	62.04	20.94	59.88	11.51
M51	28	54.96	16.88	73.18	14.40
M78	26	54.42	19.32	48.42	14.54
Total	80	57.09	19.14	60.81	16.88

Table 2: *Closure duration and VOT duration of [tˢ], split by speaker.*

Speaker	N	Proportion VOT/total duration	s.d.	Center of gravity [Hz]	s.d.
M19	26	0.50	0.08	7015	1921
M51	28	0.58	0.10	6551	1122
M78	26	0.48	0.09	7166	1273
Total	80	0.52	0.10	6902	1477

Table 3: *VOT/total duration ratio and center of gravity of [tˢ] allophones split by speaker.*

Table 4 shows the comparison between [tˢ] and [tʰ]. For [tʰ], VOT duration was shorter (51.98 ms), closure duration longer (69.55 ms) than for [tˢ]. The proportion of VOT/total duration was 0.43, that is, importantly smaller than for [tˢ]. All three parameters were statistically significant. There were no significant differences in total duration (121.52 ms for aspirated, 117.90 ms for affricated stops). Figure 1 shows the spectrogram and oscillogram of a slightly pre- and post-aspirated [st] allophone, [htʰ]. The affricate allophone [tˢ] can be observed in Figure 2, which shows clearly the high center of gravity and the long VOT duration.

	N	Closure dur. (ms)	VOT dur. (ms)	Total duration	VOT/total duration
[tʰ]	40	69.55	51.98	121.52	0.43
[tˢ]	80	57.09	60.81	117.90	0.52
p value		0.001	0.006	0.467	0.000

Table 4: *Acoustic parameters of [tˢ] and [tʰ].*
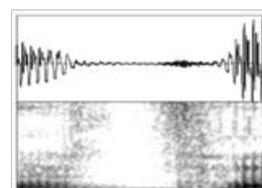
Figure 1: *Oscillogram and spectrogram of the word* pasta [ˈpahtʰa].
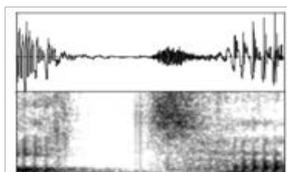
Figure 2: *Oscillogram and spectrogram of the word* fiesta *[ˈfjetˢa].*

A comparison between [tˢ] and /tʃ/ (cf. Table 5) showed that for our three speakers, the /st/ allophone had a slightly lower, ratio VOT/total duration than the palatal affricate. A within speaker comparison showed that the center of gravity of [tˢ] was higher than that of /tʃ/.

Speaker	N	Ratio VOT/total duration	s.d.	Center of gravity (ms)	s.d.
M19	10	0.57	0.08	4647	907
M51	10	0.55	0.04	4324	793
M78	10	0.53	0.07	4741	1256
total	30	0.55	0.07	4570	1020

Table 5: Acoustic parameters of /tʃ/, split by speakers.

The data coming from the acoustic measurements confirmed our assumption of the manner and place of articulation of the new sound: the high center of gravity clearly shows that the place of articulation of the new sound is more anterior than that of the palatal [tʃ]. As for the question of whether the exact place of articulation is dentoalveolar or alveolar, in the absence of direct evidence in support of one or the other possibility, we will refer to the classification of /t/ in Spanish which is normally said to be dentoalveolar ([9], p. 39), and we assume accordingly that the affricate has the same place of articulation as the stop. This innovative variant in Seville Spanish can therefore be described as a voiceless dento-alveolar affricate.

4.2. Social factors

4.2.1. Formality degree

Whereas in the less formal speech style the new sound [tˢ] accounted for 22% of occurrence of all /st/ variants, in the text and the word list, the affricate was with 13.7% (text) and 6.6% (word list) significantly less frequent. The more informal the speech style, the more frequent the affricate [tˢ] was.

4.2.2. Age

There were important differences between older and younger speakers in the frequency of occurrence of [tˢ]. The percentage of occurrence of the affricated variant decreased according to age: the [tˢ]-sound was with 35.6% much more frequent for younger speakers than for older ones. For the latter, it accounted only for 8.4%. The second generation had a value in between (21.4%). These differences among age groups were found for all three speech styles: conversation, readings and word list. The differences in frequency of occurrence were statistically significant for all formality degrees (Table 6).

4.2.3. Gender

[8] found gender differences for Antequera (a little town in the Eastern part of Western Andalusia), but not for Seville. In Antequera, women pronounced the affricated /t/ more frequently than men. In our data, the opposite trend was observed for spontaneous speech (women: 18.9%, men: 25%); but this difference was not statistically significant. For the read speech (both text and word list), there was no difference between men and women. Therefore we can conclude that, in our data, gender seems to be only a marginal factor.

	Conversation	Reading	Word list
Young	35.6%	20.6%	11.6%
Middle-aged	21.4%	15.0%	5.2%
Older speakers	8.4%	4.6%	2.9%
Pearson Chi-Square	0.000	0.000	0.000

Table 6: *Frequency of occurrence of [tˢ] according to age and formality degree.*

4.2.4. Educational level

A comparison of the three educational levels, divided according to speech style, revealed interesting differences among groups of speakers, as well as among speech styles (conversation, reading, word list).
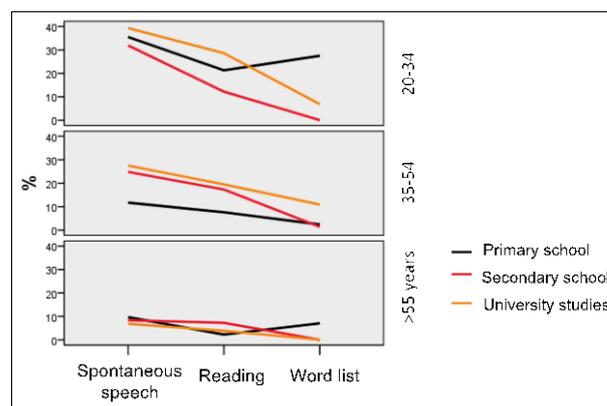
Figure 3: *Percentage frequency of [tˢ] according to age, educational level and formality degree.*

As shown in Figure 3, young and middle aged speakers who hold a university degree pronounced the affricated /t/ more often than speakers with secondary or primary educational level. This was true both for the conversation and the text reading, but not for the word list. In reading the word list, Sevillians with primary educational level produced the affricate variant even more frequently than the speakers with a university degree. Differences among groups were significant only for the word list and the text, not for the conversation. In the group of the old speakers, the differences according to educational level were less distinctive. In reading the word list, old speakers with primary studies pronounced a higher percentage of affricate allophones than those speakers with secondary or university studies.

5. Discussion

5.1. Acoustic parameters

The results presented in § 4.1 support our assumptions about a voiceless dentoalveolar affricate as an innovative variant in Seville Spanish. The duration ratio between release and total duration is comparable to that of dentoalveolar affricates in other languages (e.g. 0.40 for the alveolar affricate in Hungarian, 0.60 for [ts] in German, [11], p. 62). It was not always easy to distinguish auditorily between the aspirated and the affricated allophone. The two sounds are acoustically and auditorily very similar. It is difficult to decide how much frication is needed for an affricate, as ascertained also by Ladefoged and Maddieson: "Affricates are an intermediate category between simple stops and a sequence of a stop and a fricative. It is not always easy to say how much frication should be regarded as an automatic property of a release" ([12], p. 90).

It should be noted that there is much variation and that some affricated and aspirated /st/ allophones share acoustic cues like the VOT duration or the ratio VOT/total duration. Further analysis with a larger corpus is needed.

5.1. Social factors

The high number of affricates in the youngest generation (20-35 years) supports our supposition of a sound change in progress. At the same time, the inferior but still important number of affricates in the middle generation suggests that the new sound, rather than being stigmatized, has a certain prestige in the speech community of Seville. This, nevertheless, suggests that Sevillians may be aware of the new sound, question that has not yet been addressed.

How can the high number of affricates for primary educated speakers in the word list be explained? Here, the homogeneity within a group should be considered. There are not more speakers with primary education who realize /st/ as an affricate, but they do it in a more consistent way. That is, in this group of speakers, formality degree seems to have a smaller effect on their realization of /st/-clusters than in the higher educated speakers. In this context, another aspect has to be mentioned. In the word list, [st] was overall the most frequent realization of /st/. Probably here, in the most formal context, different /st/ variants are competing: Standard Spanish [st] and the Andalusian variants, [ht], [ht^h], [t^h] and [t^s]. We assume that in the most formal speech style, some speakers considered the Standard Spanish variant as more adequate than the local realizations. Persons who have completed only the primary school are probably less familiarized with the Standard Spanish pronunciation than speakers with a higher education, and less aware of the different registers. This might explain the raise of [t^s] frequency in the young and old speakers with a lower educational level.

6. Perspectives

Further research on the acoustic parameters of [t^s] is needed, especially on the acoustic differences between [t^s] and [t^h]. One possible way to address this question is by applying decision trees and automatic learning in order to compare our manual classification with an automatic one. This method requires a larger corpus of /st/ variants. The approach to /st/ variation in Seville Spanish in this study was acoustic and auditory. In order to further investigate the nature of sound change [t^h] → [t^s] in this variety, a perceptual study is needed.

Which acoustic cues are relevant for the perceptual discrimination of [t^h] and [t^s] by Sevillian subjects? Similarly, the question of categorical or gradual sound change could be addressed. Another important question is the place of [t^s] in the consonant system of Seville Spanish, i.e. the distinction between [t^s], /tʃ/, /s/, /t/. Furthermore, a perception study with different age groups could approach the question of sound change [ht] → [t^h] → [t^s], if we assume that there is a relationship between perception and production. A final question concerns the transmission and diffusion of the new sound. The results of [8] for Antequera suggest that the affricate exceeds the boundaries of urban Seville. A possible way to address this question is by testing which social variables are associated with the [t^s] allophone by listeners of different varieties of Andalusian Spanish.

7. Acknowledgements

8. References

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