

Eastern Andalusian Mid-Vowels: An Initial Look at Cordoban Spanish

Angel Milla-Muñoz

Indiana University

Abstract: Although the vocalic space in Spanish has been traditionally conceived as simple (Hualde 2014), researchers have demonstrated that there are some fluctuations depending on the dialect (e.g. Willis 2005) and the phonetic context (e.g. Alarcos 1958; Quilis 1999; RAE 2011). Most of the projects that have dealt with vowel opening in Spanish have coincided in two aspects: (i) they have developed a methodology based on perception tasks (e.g. Bishop 2007; Figueroa 2000) or production tasks (e.g. Sanders 1994), and (ii) of those studying Andalusian Spanish, they have been mostly focused on the province of Granada (Bishop 2007; Hualde & Sanders 1995, amongst others). Therefore, the aim of this present project is to document this phenomenon of vowel doubling at a new region of Eastern Andalusian Spanish, namely Cordoba. Moreover, the methodology of spontaneous recordings W contributes to the analysis of vernacular output of those sounds. The findings yielded that the quality of mid-vowels in Cordoba are affected by the phonetic context, especially when there is an /s/ in coda position. Not only are these vowels longer, but their height and frontness change. This initial study of the mid-vowels in Cordoban Spanish sets the point of departure for more thorough investigation of this matter.

Keywords: desdoblamiento vocálico, mid-vowels, Spanish, vowel doubling, phonetics

Introduction

The vocalic inventory of the Spanish language is said to have five vowels: /i, e, a, o, u/ (Hualde 2014; *inter alia*). However, some dialects of this Romance language seem to have doubled some of their vowels as a result of the lenition processes affecting the alveolar fricative [s] in the following contexts: coda position and word-final position (Alarcos 1958; Quilis 1999; RAE 2011). The process of vowel doubling or *desdoblamiento vocálico*, as Navarro Tomás (1939) originally coined it, consists of adding a lax counterpart to an already existing tense vowel. In Spanish, the phenomenon applies to mid-close vowels /e, o/. For example, and applicable to this project, mid-front vowel /e/ may double to [e] or [ɛ], depending on the phonetic context. For instance, the phoneme /e/ in a word like *escáner* ‘scanner’ could be realized with [e] or [ɛ] (see §2.2 for rules). According to Quilis (1999), this phenomenon of vowel doubling is not exclusive to a particular area within the Hispanic-speaking world. On the contrary, not only can this phonological process be seen in Caribbean dialects, but also in South American and Peninsular dialects.

As for Peninsular dialects, it has been described that the phenomenon takes place in Andalusia (Southern Spain), and more particularly, in Eastern Andalusian Spanish (EAS, henceforth). The different sources cited above establish

that the vocalic repertoire in this variety of Spanish adds, at least, three to five extra vowels to their system. This is a consequence of the lenition processes that [s] undergoes in this dialect, namely, aspiration and elision. Therefore, speakers will turn to these “new” vowels to compensate for the lenition process that the fricative consonant is undergoing, especially in a context where the [s] is conveying a morphemic meaning, such as plural or verbal tenses. In those cases, speakers need to mark these differences in order to minimize the lack of [s] as explained by the functional hypothesis (Kiparsky 1982). For example, in [es.tas.'ka.sas] *estas casas* ‘these houses,’ the /a/ may be fronted in order to mark the plurality expressed by the morpheme -[s].

Most of the research that surrounds this topic tends to be theoretical, or rather, descriptive. Also, there is a focus on the processes that affect the consonants rather than the vowels (Gerfen 2002; O’Neill 2010; Ruch 2013; Torreira 2006, 2007; amongst others). For those who are more attentive to the vocalic system, the most recent research shows two different trends. The first tendency believes that the idea of expanding the vocalic phonemes cannot be proposed, as there is no contrast between open and close vowels preceding [s] and its allophones (Carlson 2012). On the other hand, there is a second trend that supports this phonological change starting with a phonetic phenomenon (Herrero de Haro 2016).

In the present project, my main goal is to revisit the theories about the vocalic space in EAS, Cordoban Spanish mid-vowels in particular with empirical data, since experimental research is scarce in the field, to the best of my knowledge. Moreover, the data collected is of spontaneous nature rather than controlled production, as previous research projects have proposed.

The focus on the mid-vowels is motivated by the fact that these vowels are extremely prone to change as a consequence of their articulatory and acoustic space (RAE 2011: 113-14). Besides, I would like to study the contexts that can affect the change of vowels, especially before an aspiration or elision. This descriptive study will present an image of the current situation regarding these variables so that a new research agenda with future studies on this matter can be pursued.

The remainder of this paper will be divided in the following sections: previous literature, methodology, results, discussion, and conclusions from the results.

Previous Literature

Spanish Vowel System

The Spanish vowel system has been classified oftentimes as simple in its number of elements (RAE 2011), especially when compared to other languages, such as English or French. While Spanish is constituted with five vowels, other

languages like English may range from eight to twelve in its number of vowels, depending on the dialect and/or the speaker (Hualde 2005). When the vocalic system is compared to those of other Romance languages or even to languages not belonging to its linguistic family, it is bizarre how the different systems diverge, especially because other vocalic spaces keep their contrasts in several categories (i.e., height, nasality, amongst others), such as Portuguese (Escudero et al. 2009), Catalan (Prieto 2004), etc. However, Spanish is not the simplest language in terms of vocalic segments, since Arabic, for instance, has a three-vowel system. Figure 1 introduces the vowel system in Standard Spanish, which is shaped by three levels of tongue height (i.e., high, mid, and low) and three positions of the tongue (i.e., front, central, and back).

	Front	Central	Back
High	/i/		/u/
Mid	/e/		/o/
Low		/a/	

Figure 1. Vowel System in Standard Spanish

Next, Figure 2 shows a vowel chart containing English and Spanish vowels (Bradlow 1995), with the purpose of getting the reader acquainted with the Spanish vowel system and to establish a comparison of the vocal space of both languages.

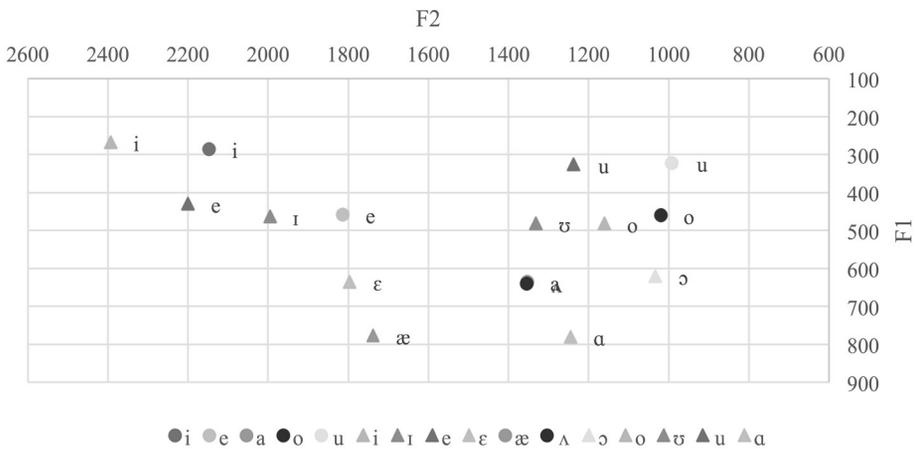


Figure 2. Comparison of the English vs. Spanish Vowels. Taken from Bradlow (1995, see Appendix for formant values).

Apart from the short number of elements, other characteristics that are assigned to the Spanish vowel system are the fact that it is stable and that it

tends not to change (Monroy Casas 1980: 9; RAE 2011: 74). Monroy Casas (1980) attributes this stability to the existing similarity between spelling and pronunciation, as in other languages such as Finnish. Similarly, and due to this so-called stability, measures such as duration do not play as important of a role as it does in other languages like English, where duration can establish phonemic contrast (22).

Despite the fact that the system is known as a stable entity, those same references recognize there can be some dialectal variations that can affect the standard quality of the vowels. As for the object of the present study, [e, o] can also undergo a process of raising in some dialects (RAE 2011: 110; Hualde 2014) and a process of lowering when in contact with other languages as in Uruguayan Spanish in contact with Brazilian Portuguese (RAE 2011). Furthermore, tonicity plays a role in the quality of the vowel, especially when in unstressed position where the vowels seems to reduce (e.g. Delforge 2008; O'Rourke 2012).

The Phenomenon: Vowel Doubling

The vowel doubling or *desdoblamiento vocálico* (firstly coined by Navarro Tomás 1939) refers to the specific phenomenon whereby vowels, especially mid vowels and low vowels, change in quality (namely in height) due to the effect of other phonetic processes such as aspiration or elision. These two processes are very common in Spanish phonetics. The fricative [s] tends to be either aspirated or elided in coda position, either word-internal or word-final (refer to rule in Figure 3). In Spanish, vowel doubling will tend to be more prevalent with the aspiration or elision of [s] in coda position (see rule in Figure 4).

$$/s/ \rightarrow \begin{cases} [h] \\ [\emptyset] \end{cases} / V _ \begin{cases} C \\ \# \end{cases}$$

Example: *vasos* /'ba.sos/ → ['ba.soh] / ['ba.so] 'glasses'

Figure 3. Lenition of [s] Rule

$$/e, o/ \rightarrow [e, o] / _ \begin{cases} [h] \\ [\emptyset] \end{cases}$$

Example: *pórtatiles* /por.'ta.ti.les/ → [por.'ta.ti.les] / [por.'ta.ti.le]

Figure 4. Vowel doubling Rule

From this definition, there has been an intense debate where researchers have positioned themselves either for or against the existence of vowel doubling in EAS. The main difference between these two groups is the categorization of this result as an either phonetic or phonological phenomenon.

Those who are against (Alarcos 1958; López Morales 1984; Quilis 1993, amongst others) mention that the rule exposed in Figure 4 is produced, although they do not recognize the functional load conveyed by the vowels enough to make them part of the generic and already established vocalic system. López Morales (1984) also states that the idea of plurality carried by the morpheme *-[s]* can also be determined by the context (i.e. pronouns, articles). Alarcos (1958) states that the loss of *[s]* results in a modification of the following consonant. More recently, Carlson (2012) through a perception study with natives of EAS concluded that there was no ‘compensatory mechanism’ (i.e., vowel doubling) for them to assess the disambiguation between plural or singular marking. However, she did find that vowel lengthening was helpful in order to distinguish words in medial position as opposed to final positions. Thus, she does not believe in the extension of the vocalic space for Spanish in Eastern Andalusia. Although what was exposed by the first group may be true, there is another group of researchers who believe that the outcomes of vowel doubling should be included at the phonological level. Most of them concur that not all vowels will double, especially the high ones (*vid* Alonso et al. 1950; Salvador 1987; *inter alia*).

There have been studies that also developed their research on vowel doubling in other areas of the Hispanic world, but the most relevant area has been the Caribbean (Figueroa 2000; Hammond 1978, for instance). As for Peninsular Spanish, the main studies on EAS have been focused on the region of Granada (Bishop 2007; Hualde & Sanders 1995; López Morales 1984; Sanders, 1994), and from there, they generalize their results to the other regions where EAS is considered to be spoken. In these studies, there is a general tendency to assess the phonological values of vowel doubling with perception tasks (Bishop 2007; Figueroa 2000; Hammond 1978). It is interesting to observe that, regardless of their research location, all of the articles cited performing a perception task found that there were no phonological cues to determine the difference between singular and plural. Bishop (2007) claims that the neutralization of *[e, o]* and its open counterparts in the context studied is complete in this sense. Others preferred to assess the phenomenon with production tasks such as reading (Sanders 1994) and open interviews (López Morales 1994). In both studies, the vowel quality, measured by its F1 & F2 values, was the marker for number (i.e. plural *vs.* singular).

Addressing other empirical studies, it is central to pay attention to Herrero de Haro (2016), since he has studied vowel doubling in another region of EAS, Almeria (east of Granada). This researcher goes beyond and studies the phenomenon not only in the typical contexts of aspirated or elided *[s]*, but also in other codas with other sounds where those are also elided, namely in *[r]* and *[θ]*. However, his focus was only on the mid-front vowel, */e/*. He divided his research into two tasks: the first one was devoted to production via a reading task with 4 participants, and he concluded there might be four different allophones (*[e]*, *[e^s]*, *[e^r]*, and *[e^θ]*, Herrero de Haro’s notation) due to the different values of F1 and

F2 each context yielded. Given this fact, he decided to assess if there were any phonological implications with a perception task. This task generated some striking results, as the perception of all of four contexts were statistically significant except for [e^h]. This means, according to the researcher, that there is a phonological contrast amongst the first three contexts he did consider in his study.

Finally, I would like to finish this section with Rodriguez Castellano & Palacio's (1948) study, as this has been the only study, to the best of my knowledge, devoted to the region studied in the present project. In their study, they contribute to the field with the confirmation of the existence of new variants of [e, o] in the region, comparing their nature to their counterparts in French and Catalan. They also make special mention to the fact that plurality is a context that really favors this phenomenon. In order to reach to these conclusions, these researchers used questionnaires and palatograms.

Research Questions and Hypotheses

Based on previous literature, this present paper will attempt to resolve the following questions:

RQ1. Will empirical data confirm the phenomenon of vowel doubling in Cordoban Spanish as a subpart of EAS?

RQ2. If RQ 1 holds true, which contexts will determine the vowel doubling?

RQ3. Will there be any difference between aspiration or elision contexts?

Monroy Casas (1980) stated that unstressed mid-vowels [e, o] have the following tendencies: centralization, slight raising and slight lowering (10), and RAE (2011) claims that the weakening processes such as the elision of [s] has an effect on the height of the vowel. Considering these effects, my main hypothesis is that there will be vowel doubling in Cordoban Spanish as it has also been certified by other regions in previous studies. As for the contexts (*i.e.* aspiration or elision), I expect no difference, as the vowels produced will tend to be open since speakers need to compensate the fact that the morphological suffix -[s] is not present in compliance with the Functional Hypothesis (Kiparsky 1982), regardless of the lenition process in progress.

Methodology

Subjects

For this project, a corpus has been created with recordings from a regional TV channel. The programs were downloaded from the channel's official website

of the TV channel. The show selected is called *Este es mi pueblo*. In this broadcast, people from a specific town talk about their town, describing their traditions, their gastronomy, their daily routine, their expressions, etc. The selection of this TV show lies in the fact that its participants use vernacular speech, which will contribute to the search for successful tokens in this research. Furthermore, this type of data will also contribute to give a new perspective to the research, since earlier projects used a more controlled production, such as carrier sentences or isolated tokens (Carlson 2012; Figueroa 2000; amongst others).

As stated in the previous literature, most of the research done so far has been focusing on Granada and Almería, which are located at far east of the Andalusian region (see Figure 5).



Figure 5. Map of Andalusia Divided by Subdialect. (Source: https://commons.wikimedia.org/wiki/File:West-East_provinces_of_Andalusia-2.svg)

Procedure and Analysis

Once the TV shows are recorded, I proceeded to select the necessary tokens for this research in the context of /Vs/. Since the objective is to study where the mid-vowels stand nowadays, two groups of vowels have been created:

1. A “control group” of vowels that will set the values to which the values in group 2 will be compared. In this group, the vowels included have no influence of any other phonetic process including allophony such as nasalization that could interfere in the quality of the vowel and preferably those with this structure /sV/, e.g. [ˈθé.sar] *César* ‘Caesar’.
2. A second group consisting of tokens that have the structure /Vs/ but in contexts where [s] is aspirated or elided, that is, in coda position or in word-final (as seen in Figure 3 of this present paper). For instance, the word [ˈto.h.ko] *tosco* ‘uncouth’ shows an example of this phenomenon.

I selected all the tokens that appeared in the recording based on the following factors: **stress** (stressed/unstressed) and **context** (full [s] vs. aspirated or deleted [s]). The drawback to this inductive system is that numbers cannot be balanced, since the amount of tokens is contingent upon the productions of the speakers during the recording. The following table sums up these two factors in relation with the two vowels.

Vowel	Stress	Context
e	stressed unstressed	full [s] aspirated/ deleted [s]
o	stressed unstressed	full [s] aspirated/ deleted [s]

Table 1. Variables in the Present Study

After all the tokens were collected ($N=320$), they were analyzed with the software *Praat* (Boersma & Weenik 2017) and coded according to the following coding scheme:

1. Stress: stressed or unstressed
2. Presence of [s]: full [s] or aspirated/deleted [s]
3. Vowel quality: F1 and F2 values
4. Position in the word: word-internal vs. word-final
5. Following context: consonant vs. vowel vs. pause
6. Sex: men vs. women

For the measurement of the F1 and F2 values, the midpoint of each vowel was selected, and then those values were obtained with the help of an algorithm or script (Lennes 2003). The selection of the midpoint is justified by the fact that it would be best to measure the vowel at a point where it is free from the contact effects of the preceding and the following vowels so as to avoid the formant transitions. In order to verify that the script was working accurately, I compared manual measurements to those that the script took.

After taking those measurements, the tokens were normalized in their F1 and F2 values with the NORM suite (Thomas & Kendall 2007) using the Watt & Fabricius method (*vid* Fabricius et al. 2009 to expand our knowledge on how the algorithm works). This method was selected as the most appropriate because it plots the vowels taking into consideration the three extremes of a vocalic chart, that is, /i, a, u/, which *a priori* creates a friendlier graph for the audience. The NORM suite allow users to easily convert F1 and F2 values to normalized values. The rationale behind the normalization of values is due to the nature of the data. Since male and female speakers have different vocal tracts, the

generalizations could be expanded at a higher degree using their normalized values (Adank et al. 2004).

Due to the descriptive and preliminary nature of this project, no statistical analysis will be included, although it is strongly encouraged for future research.

Results and Discussion

In the present section, results are presented. Starting with some descriptive data (see Tables 2, 3, 4, & 5 below), the tokens analyzed yielded the following raw frequencies: 47.5% ($N=152$) of the tokens were the mid-front vowel [e], whereas 52.5% ($N=168$) of the data represented the mid-back vowel [o]. Next, as it could be expected, the unstressed vowels (80.94%, $N=259$) outnumbered the stressed productions (19.06%, $N=61$) due to their frequency. When examining the context according to the status of the fricative [s], the aspirated [s] variant, *i.e.* [h], was the context that had the highest number of instances (54.06%, $N=173$). This was followed by the elided [s] (25.31%, $N=81$), and finally, the full [s] with 20.63% ($N=66$). In this factor, frequency may also play a role in order to explain the numbers, because [s] is a sound that is more associated with the coda position. The next factor is word-position. This factor revealed that final position (72.81%, $N=233$) was also more frequent than internal position (27.19%, $N=87$) by a large difference. Finally, for the following segment, the data indicates that the most prominent context is the one followed by a consonant (69.38%, $N=222$). Next are relegating vowels (15.94%, $N=51$) followed by pauses (14.69%, $N=47$).

General frequencies	47.5% ($N=152$) for [e]	52.5% ($N=168$) for [o]
Stressed tokens	19.06%, $N=61$	
Unstressed tokens	80.94%, $N=259$	

Table 2. Raw Frequencies per Vowel and According to Stress

Full [s]	20.62%, $N=66$
Aspirated [s]	54.06%, $N=173$
Elided [s]	25.31%, $N=81$

Table 3. Raw Frequencies According to the Production of /s/

Final Position	72.81%, N=233
Internal Position	27.19%, N=87

Table 4. Raw Frequencies According to the Position of /V/ within the Word

Followed by consonant	69.38%, N=222
Followed by vowel	15.94%, N=51
Followed by pause	14.69%, N=47

Table 5. Raw Frequencies According to Following Segment

Duration is a measurement that it is not considered relevant in Spanish phonetics and phonology, given that it is not a distinctive feature at the phonological level as it can be for other languages such as English. In this case, duration is considered in this paper so as to verify if there were any differences. According to the data, the duration of the mid-vowels pronounced in a context where [s] is fully realized matches the regular durations reported by other studies, as Morrison and Escudero (2007). The typical duration for [e, o] in Peninsular Spanish is from 65ms to 70ms. The data from Cordoba is in line with these numbers, as their average duration is 65ms. When more variation is perceived, it is in the context of aspiration or elision. The values for [e] and [o] are somewhat reversed, depending on the context. One plausible explanation is that there could be an effect from some of the tokens due to their frequency, namely the third-person singular of the verb “to be”, *es* [es] > [ɛ]. With this token in particular (i.e. *es*), it has been observed that the duration of this token was so salient that it was even perceivable to the human ear without the need of an acoustic analysis. The next table, Table 6, shows the values of both vowels in the three contexts.

	[e]		[o]	
Full [s]	65	*65~70	65	*65~70
Aspirated [s]	81		102	
Elided [s]	118		85	
<i>*Values on the right are mean vowel duration for Peninsular Spanish (Morrison & Escudero 2007)</i>				

Table 6. Duration Measured in the Three Contexts of [s] in ms

After studying the duration, I am now focusing on the vowels in each of the contexts with [s]. The first plot is a general plot that contains all 320 tokens from the present study (see Figure 6 below). In order to understand it, we have to read it upside down, where higher values in the F1 axis means higher degree of vocalic height, and higher values in the F2 axis means higher degree of frontness.

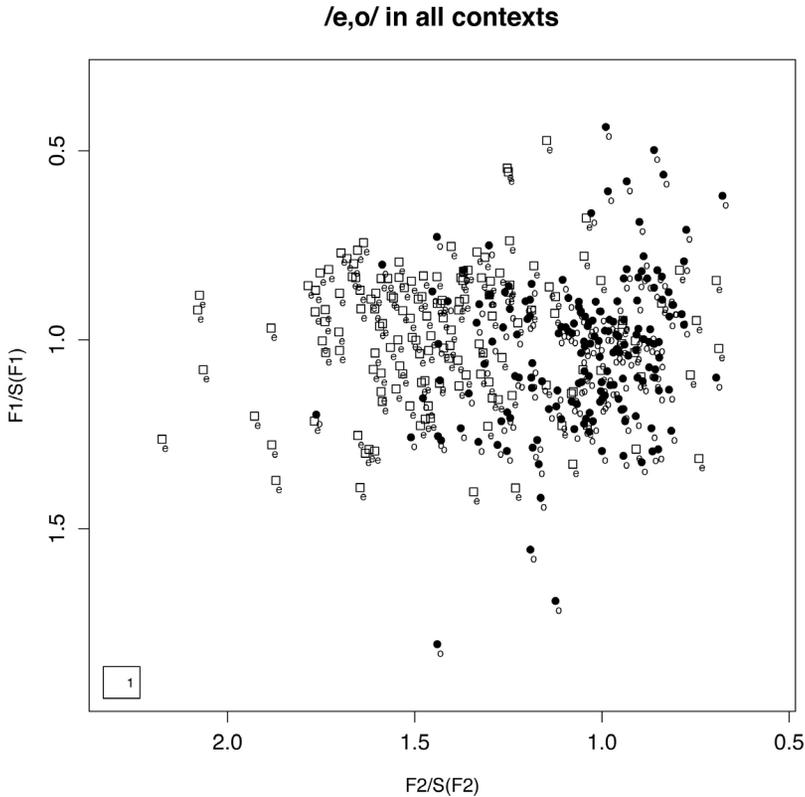


Figure 6. Scatterplot of Cordoban Spanish Mid-Vowels [e, o]

This scatterplot shows us that the vowels [e, o] share some space in common. If we take into consideration the three actions this type of vowel may have, according to Monroy Casas (1980), we can see that those three patterns (i.e. centralization, slight raising, and slight lowering) are present in this representation with all the realizations in this scatterplot, regardless of the outliers.

In Figure 7, the vowels plotted here are those who were in contact with [s], but this [s] did not undergo any phonological or phonetic process, such as assimilation, etc. It is observable that some of the mid-vowel [e] have become more back, however, this is not the general trend. They seem to remain stable in the same position or area, as an effect of the presence of [s].

In Figure 8, the phenomenon of vowel doubling does not seem to be fully realized, as the vowels and its acoustic measurements are not behaving in the expected way. Even though these data are at a preliminary stage, in light of what this scatterplot offers, the vowel doubling does not seem to be conditioned by the elision of [s]. This conclusion goes against the Functional Hypothesis (Kiparsky 1982), as vowel doubling would not be an acoustic cue to convey morpho-syntactic information such as plurality or verb morphology. However, even with this data, we should not reject the hypothesis completely, since speakers may find other resources to compensate the loss of the natural marker for plurality or verbal morphology.

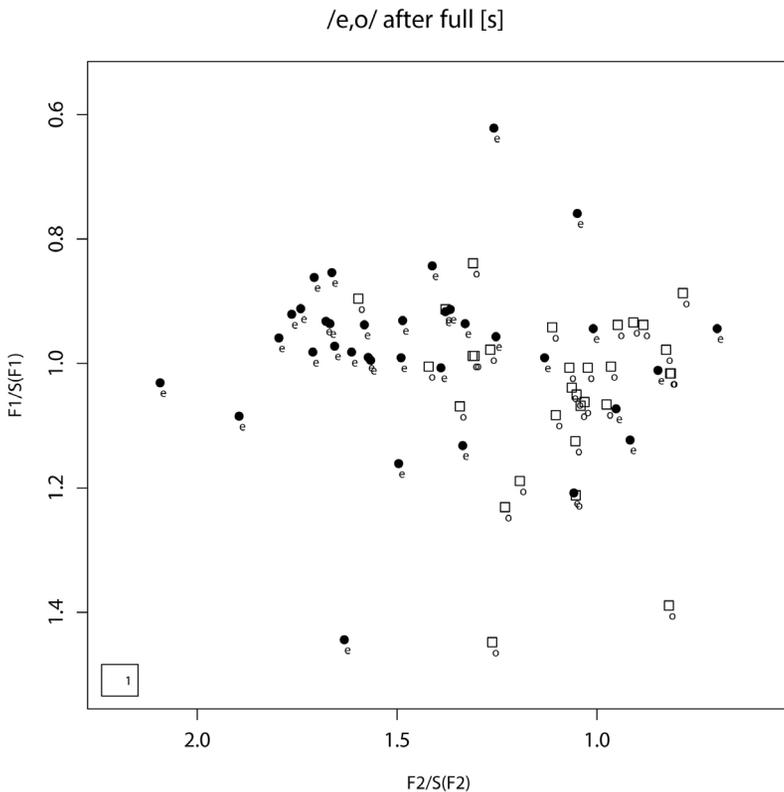


Figure 7. Scatterplot of Cordoban Spanish mid-vowels [e, o] with full [s]

Figure 9, compared to Figure 8, behaves differently because the vowels seem to be opening more. Although looking at the existing data, we cannot affirm that they do it at a high rate. The movement portrayed by the scatterplot may make us think that something is happening and that it should be related to the aspiration of the fricative [s]. A fact like this would make me position myself against the group that recognized the existence of vowel doubling, which wanted to have a part of the phonological system.

To finish this section and with the purpose of establishing more cross-linguistic connections, I would like to create a connection between the variety studied and

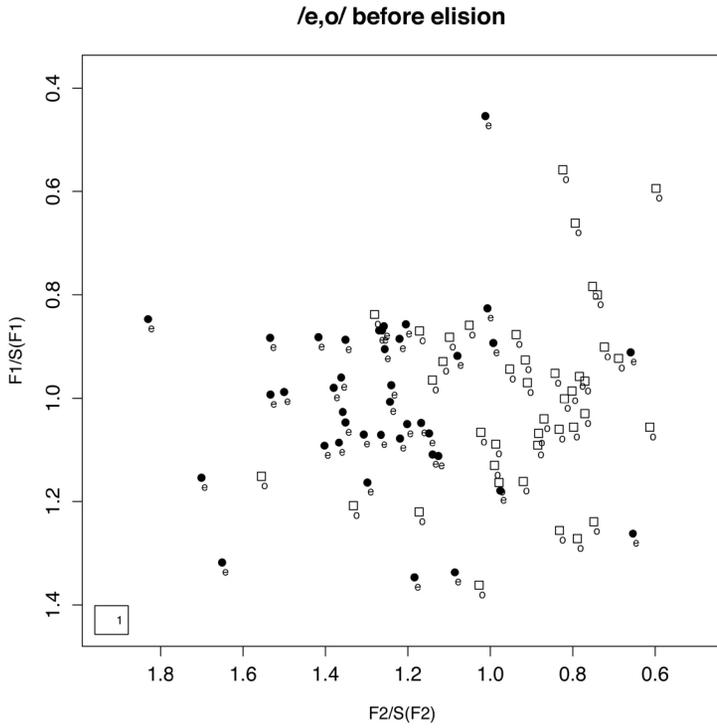


Figure 8. Scatterplot of Cordoban Spanish mid-vowels [e,o] before elided [s]

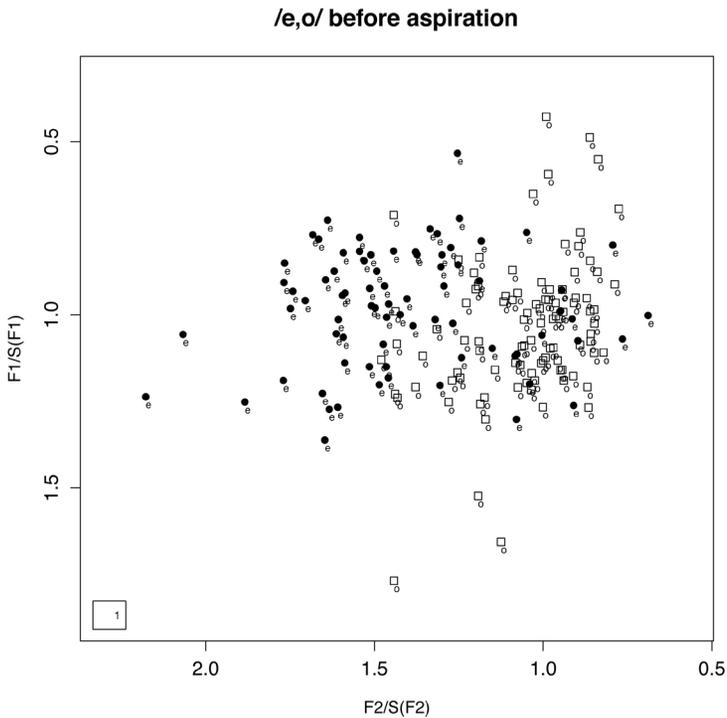


Figure 9. Scatterplot of Cordoban Spanish mid-vowels [e,o] before aspirated [s]

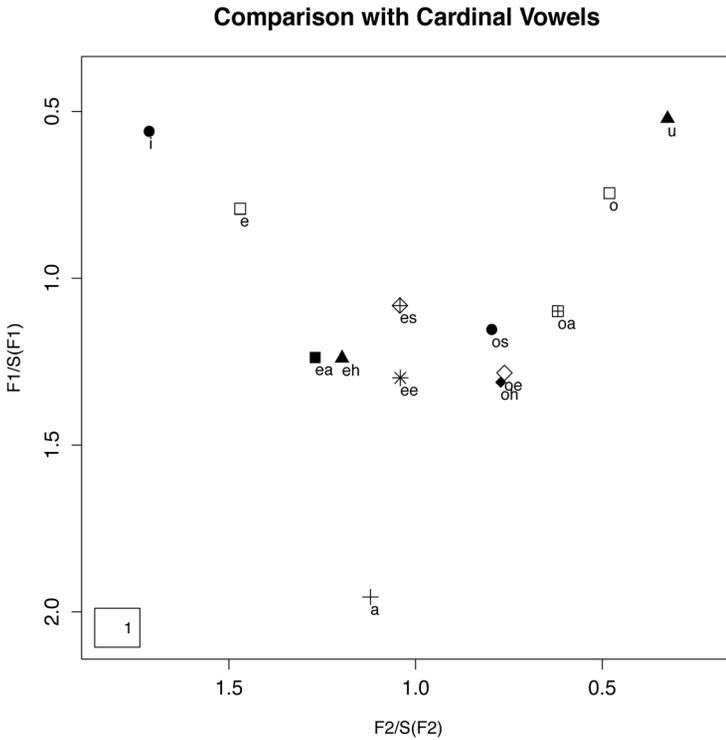


Figure 10. Scatterplot of Cordoban Spanish Mid-Vowels [e, o] in All Three Contexts Affected by [s] and Compared to the Vocalic Productions by Daniel Jones

the English language. The last scatterplot, Figure 10, represents a comparison with a set of the Cardinal Vowels produced by Daniel Jones, whose values were taken from Thomas (2011). The objective of this plot is to put into perspective the reality portrayed by the data from this project and neutral values, so that any reader from any language may find a point of reference with which to compare. As for this scatterplot, we need to pay attention to the legend because *ee* refers to [e] before elided [s], *eh* refers to [e] before aspiration, and *es* refers to [e] before full [s]. The symbols are the same for the [o] counterpart. When compared to Jones' vowels, we can see a movement towards more opening, especially in *ee* and *eh* variants, although the movement is very slight and those two contexts seem to develop together. In the case of [o], the changes seem to go slower and additionally, it can be seen as a raising of [o].

In summary and following the research questions posed for this project, it can be stated that the vocalic system in Cordoban Spanish is not as stable as it may seem when there is a vocalic context followed by [s]. Figures 8 and 9 represent the beginning of this vocalic opening, and thus, this empirical data confirm a gradual existence of vowel doubling in Cordoban Spanish. This idea applies mainly to vowels in contact with [s] in coda position. There were different realizations depending on the final allophonic outcome of [s]: centralization for full realization and elision, and slight lowering to /a/ for aspiration. Finally, these

mid-vowels in contact with allophones of /s/ have showed that their durations are also longer than those preceded by /s/.

Conclusions and future directions

In the present paper, I sought to contribute to the studies of vowel doubling in Eastern Andalusian Spanish. By bringing acoustic and empirical data, the phenomenon has been confirmed, and thus, research question 1 has been answered. Additionally, I have aimed to establish a relationship between the vowel doubling and phonetic processes that affect the fricative [s] in Spanish through the creation of a corpus where vernacular speech was present. Paying attention to research questions 2 & 3, the current study yielded the following results: even though vowel doubling is believed to be perceived by humans clearly, the acoustic analysis proved that there was general centralization for all contexts and slight lowering to /a/ in an aspirated context. Moreover, the duration of the segments was different depending on the phonetic context.

For future studies, it would be advisable to increase the number of tokens as well as to have a more controlled set of data that can posit a definite status of vowel doubling in the region of Cordoba, Spain. Furthermore, and with the objective of supporting the explanation of this phonetic process, it would be recommended to include statistical analysis in order to show the strength of the factor than can intervene in the production of vowel doubling in Eastern Andalusian Spanish. If it is likely to become a more phonological phenomenon, then, more perception studies should be performed, especially using duration as a cue to differentiate mid-close to mid-open vowels.

Appendix

F1 and F2 values for the English and Spanish vocalic spaces (data taken from Bradlow 1995).

A. Spanish Vowels

	i	e	a	o	u
F1	286	458	636	460	322
F2	2147	1814	1353	1019	992

B. English Vowels

	i	ɪ	e	ɛ	æ	ʌ	ɑ	ɔ	o	ʊ	u
F1	268	463	430	635	777	640	780	620	482	481	326
F2	2393	1995	2200	1796	1738	1354	1244	1033	1160	1331	1238

Works Cited

- Adank, Patti, et al. (2004). "A Comparison of Vowel Normalization Procedures for Language Variation Research." *The Journal of the Acoustical Society of America* 116: 3099-107. Print.
- Alarcos, Emilio. (1958). "Algunas consideraciones sobre la evolución del consonantismo catalán." *Miscelánea Homenaje a A. Martinet. Estructuralismo e historia*: 5-40. Print.
- Bishop, Jason B. (2007). "Incomplete Neutralization in Eastern Andalusian Spanish: Perceptual Consequences of Durational Differences Involved in S-Aspiration." *Proceedings of the International Congress of Phonetic Sciences*. Eds. Trouvain, Jürgen and William J. Barry. Vol. 16. Saarbrücken, Germany: Universität des Saarlandes. 1765-68. Print.
- Boersma, Paul, and David Weenink. (2017). *Praat*. Vers. 6.0.28. Computer software.
- Bradlow, Ann R. (1995). "A Comparative Acoustic Study of English and Spanish Vowels." *The Journal of the Acoustical Society of America* 97.3: 1916-24. Print.
- Carlson, Kristin M. (2012). "An Acoustic and Perceptual Analysis of Compensatory Processes in Vowels Preceding Deleted Post-Nuclear [s] in Andalusian Spanish." *Concentric: Studies in Linguistics* 38.1: 39-67. Print.
- Delforge, Ann M. (2008). "Unstressed Vowel Reduction in Andean Spanish." *Selected Proceedings of the 3rd Conference on Laboratory Approaches to Spanish Phonology*. Eds. Colantoni, Laura and Jeffrey Steele. Somerville, MA: Cascadilla Proceedings Project. 107-24. Print.
- Escudero, Paola, et al. (2009). "A Cross-Dialect Acoustic Description of Vowels: Brazilian and European Portuguese." *The Journal of the Acoustical Society of America* 126.3: 1379-93. Print.
- Fabricius, Anne H, et al. (2009). "A Comparison of Three Speaker-Intrinsic Vowel Formant Frequency Normalization Algorithms for Sociophonetics." *Language Variation and Change* 21.3: 413-435. Print.
- Figuroa, Neysa. (2000). "An Acoustic and Perceptual Study of Vowels Preceding Deleted Post-Nuclear [s] in Puerto Rican Spanish." *Hispanic Linguistics at the Turn of the Millennium: Papers from the 3rd Hispanic Linguistics Symposium*. Eds. Campos, Héctor, et al. Somerville, MA: Cascadilla Press. 66-79. Print.
- Gerfen, Chip. (2002). "Andalusian Codas." *Probus* 14.2: 247-77. Print.
- Hammond, Robert. (1978). "An Experimental Verification of the Phonemic Status of Open and Closed Vowels in Caribbean Spanish." *Corrientes actuales en la dialectología del caribe hispánico*. Ed. Lopez Morales, Humberto. San Juan, PR: Universidad de Puerto Rico. 33-125. Print.
- Herrero de Haro, Alfredo. (2016). "Four Mid Front Vowels in Western Almeria: The Effect of /s/, /r/, and /θ/. Deletion in Eastern Andalusian Spanish." *Zeitschrift Fur Romanische Philologie* 131.1: 118-48. Print.
- Hualde, José Ignacio (2014). *Los Sonidos Del Español: Spanish Language Edition*. New York: Cambridge University Press. Print.
- . (2005). *The Sounds of Spanish*. New York: Cambridge University Press. Print.

- Hualde, José Ignacio, and Benjamin P Sanders. (1995). "A New Hypothesis on the Origin of the Eastern Andalusian Vowel System." *Proceedings of the 21st Annual Meeting of the Berkeley Linguistics Society*. Eds. Bilmes, Leela, Anita C. Liang and Weera Ostapirat. Berkeley, CA: University of California. 426-37. Print.
- Kiparsky, Paul (1982). *Explanation in Phonology*. Berlin: de Gruyter. Print.
- López Morales, Humberto. (1984). "Desdoblamiento fonológico de las vocales en el andaluz oriental: Reexamen de la cuestión." *Revista Española de Lingüística Madrid* 14.1: 85-97. Print.
- Monroy Casas, Rafael. (1980). *Aspectos fonéticos de Las vocales españolas*. Madrid, Spain: Sociedad General Española de Librería. Print.
- Navarro Tomás, Tomás. (1939). "Desdoblamiento de fonemas vocálicos." *Revista de filología hispánica* 1: 165-67. Print.
- O'Neill, Paul. (2010). "Variación y cambio en las consonantes oclusivas del español de andalucía." *Estudios de Fonética Experimental* 19: 11-41. Print.
- O'Rourke, Erin. (2012). "Intonation in Spanish." *The Handbook of Hispanic Linguistics*. Eds. Hualde, José Ignacio, Antxon Olarrea and Erin O'Rourke. Chichester, UK: Wiley-Blackwell. 173-91. Print.
- Prieto, Pilar. (2004). *Fonètica i fonologia: Els sons del català*. Barcelona: Editorial UOC. Print.
- Quilis, Antonio. (1993). *Tratado de fonología y fonética españolas*. Madrid: Gredos. Print.
- Real Academia de la Lengua Española. (2011). *Nueva gramática de la lengua española: Fonética y fonología*. Barcelona: Espasa Libros. Print.
- Rodríguez-Castellano, Lorenzo, and Adela Palacio. (1948). "El habla de cabra." *Revista de dialectología y tradiciones populares* 4.3: 387-418. Print.
- Ruch, Hanna. (2013). "Investigating a Gradual Metathesis: Phonetic and Lexical Factors on [s]-Aspiration in Andalusian Spanish." *University of Pennsylvania Working Papers in Linguistics* 19.2: 171-80. Print.
- Salvador, Gregorio. (1987). *Estudios Dialectológicos*. Madrid: Paraninfo. Print.
- Sanders, Benjamin P. (1994). "Andalusian vocalism and related processes." Diss. University of Illinois at Urbana-Champaign. Web. 4 Nov. 2016.
- Thomas, Erik R. (2011). *Sociophonetics: An Introduction*. Basingstoke, UK: Palgrave Macmillan. Print.
- Thomas, Erik R., and Tyler Kendall. (2007). *Norm: The Vowel Normalization and Plotting Suite*. [Online Resource: <http://ncslaap.lib.ncsu.edu/tools/norm/>]
- Torreira, Francisco. (2006). "Coarticulation between Aspirated-S and Voiceless Stops in Spanish: An Interdialectal Comparison." *Selected Proceedings of the 9th Hispanic Linguistics Symposium*. Eds. Sagarra, Nuria and Jacqueline Almeida Toribio. Somerville, MA: Cascadilla Proceedings Project. 113-20. Print.
- . (2007). "Pre- and Postaspirated Stops in Andalusian Spanish." *Segmental and Prosodic Issues in Romance Phonology*. Eds. Mascaró, Joan, Maria-Josep Solé and Pilar Prieto. Amsterdam: John Benjamins. 67-82. Print.
- Willis, Erik W. (2005). "An initial examination of Southwest Spanish vowels." *Southwest Journal of Linguistics* 24.1-2: 185-199. Print.