ZrP 2017; 133(1): 82–114 DE GRUYTER

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Four mid back vowels in Eastern Andalusian Spanish

The effect of /s/, /r/, and /θ/ deletion on preceding /o/ in the town of El Ejido

DOI 10.1515/zrp-2017-0004

Abstract: The deletion of syllable-final consonants in Eastern Andalusian Spanish has been extensively documented; however, there is no consensus about its effect on neighbouring vowels. Researchers have focused on the effects of /s/ deletion on vowels to analyse how its semantic value is conveyed, while other consonants which are also deleted have been ignored. This paper examines the effects of word-final /s/, /r/, and /θ/ deletion on preceding /o/ from the point of view of production and perception. Regarding production, acoustic analyses of data from El Ejido (Eastern Andalusia), show specific changes to the F1 and F2 of /o/ depending on the underlying consonant it precedes (/s/, /r/, or /θ/). Likewise, a perception test demonstrates that Eastern Andalusian speakers can distinguish between more types of mid back vowels than previously thought.

Keywords: vowel doubling, Eastern Andalusian vowel system, consonant deletion, Andalusian Spanish phonetics, Spanish phonology

1 Introduction

As first explained in Schuchardt (1881), Wulff (1889) and Navarro Tomás (1938; 1939), Eastern Andalusian Spanish (henceforth EAS), deletes most syllable-final

Note: This work has been funded by the Faculty of Law, Humanities, and the Arts of the University of Wollongong (Australia) and by a Hispanex grant from the Spanish Ministry of Education, Culture, and Sport. I would like to thank staff and students at the following schools for helping me gather the necessary materials for this research project: I.E.S. Fuente Nueva (El Ejido); I.E.S. Santo Domingo (El Ejido); C.E.I.P. Laimún (El Ejido); I.E.S. Mar Azul (Balerma); I.E.S. Virgen del Mar (Adra); and I.E.S. Abdera (Adra).

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consonants, although there is no consensus on the effects that coda deletion has on surrounding vowels.

There has been great interest in studying EAS since 1881, although researchers have focused mainly on the effects of /s/ deletion on vowels (Herrero de Haro, in press a). Navarro Tomás (1938; 1939) and Alvar (1973, map 1696) posit that vowels open before aspirated or deleted coda /s/ and that these vowels gain phonemic value. This has been supported by acoustic evidence presented in Martínez Melgar (1994) and Sanders (1998), although López Morales (1984), Mondéjar Cumpián (1979), and Martínez Melgar (1986) consider vowel opening a phonetic feature. Apart from debating on whether vowel opening is a phonetic or phonological feature, there are also different views regarding which vowels open before underlying /s/: for Navarro Tomás (1938; 1939), only /a/, /e/, and /i/ open, Salvador (1977) believes that all vowels open except /u/, while, according to Peñalver Castillo (2006) and Martínez Melgar (1994), all vowels open. For Villena Ponsoda (2000), this vowel opening marks the difference between Eastern and Western Andalusia.

Herrero de Haro (in press a) illustrates the lack of agreement between scholars regarding the effect of consonant deletion on preceding vowels. In fact, there is not even consensus on whether coda-final consonants are aspirated or deleted. For Navarro Tomás (1938; 1939) and for García Marcos (1987), EAS coda-final /s/ can be either aspirated or deleted, whilst Gerfen (2002) claims that /s/ is not completely deleted. Furthermore, Peñalver Castillo (2006) and Tejada Giráldez (2012), amongst others, present different realisations of /s/ even within the same town, which they link to different sociolinguistic characteristics.

However, despite the deletion of most coda consonants in EAS, deleted syllable-final /s/ has been considered the only underlying consonant which changes the quality of a preceding vowel, acquiring a new phonemic value which carries the semantic function of deleted /s/ (Salvador 1957; Carlson 2012); other authors, on the other hand, reject this phonemicisation (Alarcos Llorach 1958; López Morales 1984). This paper presents a more complex reality of EAS *desdoblamiento* (henceforth *vowel doubling*, following the English translation in Hualde and Sanders 1995), showing how consonant deletion forms a new system of, at least, four mid back vowels.

Navarro Tomás (1938; 1939) and Alvar (1973), amongst others, describe how syllable-final /s/, /r/, and /θ/ are deleted in EAS; however, speakers of this geolect can still differentiate between words such as *le* and *les*, *ves* and *ver*, and *ve* and *vez* (Herrero de Haro 2016); the mechanisms operating in these distinctions are still unclear. Despite these differences between EAS and Castilian Spanish (henceforth CS), the term *dialect* will be avoided in this paper, as the peculiarities of EAS are almost exclusively related to pronunciation (Mondéjar Cumpián 2011, 34, in Valeš 2014).

This paper will study the difference between word-final /o/ and /o/ preceding underlying word-final /s/, /r/, and /θ/ (henceforth *[o^{s}]*, *[o^{r}]*, and *[o^{θ}]*, respectively) to establish whether the deletion of these consonants creates consistent changes to the F1 and F2 of /o/, as it was the case with /e/ in Herrero de Haro (2016). After establishing whether the deletion of /s/, /r/, and /θ/ creates a new set of mid back vowels, data from a perception test will determine whether EAS speakers from Western Almería can distinguish between [o], [o^{s}], [o^{r}], and [o^{θ}]. It is worth noting that throughout this paper, consonants written in superscript (e.g. [^{s}], [^{r}], and [^{Θ}]) represent underlying consonants.

Some scholars have already noted differences on the effects that the deletion of other consonants has on preceding vowels, although this has not been analysed in detail. For example, Wulff (1889) noticed syllable-final consonant deletion in EAS in words like *vos* or *voz*. Wulff (ib.) identified different effects on vowels depending on what consonant had been deleted, which he transcribed: *toros* (toroh); *abrasador* (abrasao:); *soledad* (soleá); *cruz* (kruh); *espada* (empa:); *toril* (tori:); *pasar* (pasa·). Likewise, Alvar (1973, maps 1626 and 1629), who studies the Spanish words *tos* and *voz*, explains that in certain towns, as in Algarinejo (Gr303), Escúzar (Gr503), and Alboloduy (Al501), /s/ and /θ/ deletion change the quality of the preceding /o/ in a different way, allowing native speakers from these towns to differentiate /os/ from /oθ/ despite coda deletion. Navarro Tomás (1938) had already identified different types of vowel opening, explaining that /l/ and /r/ do not systematically trigger opening of preceding vowels, but that if they do, they show a lesser degree of opening than vowels preceding underlying /s/. Despite this, no further analysis has been carried out to establish whether that type of vowel opening has phonemic value. To my knowledge, those are the only instances in which EAS vowel quality has been identified as the feature carrying the functional load of deleted consonants other than /s/. Gerfen/Hall (2001) commented on this in their study of word-medial vowels preceding underlying /s/, /k/, and /p/:

> "Although much attention has been paid to word-final s-aspiration because of its role in preserving semantic contrasts, there has been little focus on whether other contrasts are also maintained when coda aspiration is implemented".

Alarcos Llorach (1976, 12) claims that phonetic-phonological changes in a language tend to affect multiple sounds, which prompted the present study and Herrero de Haro (2016). As posited in Alarcos Llorach (1976, 122), new developments solve ambiguity when some distinctions are lost in a phonemic system. Thus, in EAS, vowel quality may be used to mark deleted /s/, /r/, or /θ/ after /o/, creating new phonetic contrasts; a perception test will determine whether EAS speakers can differentiate [o], [o^{s}], [o^{r}], and [o^{Θ}].

Such phonological debate is complex; EAS vowel opening is believed by some, such as Salvador (1957; 1977), Sanders (1998) and Carlson (2012), to mark syllable-final /s/ deletion, thus carrying out the semantic function of deleted /s/ and making these open vowels phonemes. In contrast, López Morales (1984) and Martínez Melgar (1986) admit that /s/ deletion causes vowel opening but they consider this a phonetic feature. Likewise, the restriction of vowel opening to word-final position is also seen by Contreras Jurado (1975) and Cerdà Massó (1992) as evidence that this cannot be a phonemic feature, although Gerfen/Hall (2001) established that there are differences word-internally between vowels preceding /s/, /k/, or /p/ deletion. On the other hand, Alarcos Llorach (1958; 1983), Contreras Jurado (1975) and Cerdà Massó (1992) propose vowel system doubling instead of vowel doubling; all in all, previous studies have only considered /Vowel/ vs /Vowel + deleted /s// (/V/ vs /V^{s}/) and this paper aims to analyse other contrasts to ascertain whether EAS speakers can differentiate between [o], [o^{s}], [o^{r}], and [o^{θ}].

To examine this, samples recorded in the town of El Ejido will be analysed acoustically to establish F1 and F2 values for word-final /o/ and for /o/ preceding underlying word-final /s/, /r/, and /θ/. After this, a perception test with native speakers of El Ejido and from two surrounding towns will determine if these speakers can differentiate between different types of /o/.

This perception study also aims to explore an underresearched aspect of EAS, as "it is production which has typically been the focus of this line of research" (Bishop 2007). Studies analysing the phonemic inventory of EAS tend to focus on vowels, consonants, and other features of this geolect, but insufficient attention is given to how EAS native speakers perceive these sounds (i.e. whether they can notice the slight nuances which distinguish, at least phonetically, different consonants and vowels in EAS). As explained in Herrero de Haro (in press b), "speakers of a language, or of a geolect in our case, bestow on sounds the category of phonemes inasmuch these sounds contrast meaning in the speakers' minds", and I believe that a phonological debate regarding EAS vowels must take into account whether EAS speakers can, in fact, differentiate between vowels.

Several scholars, such as Rodríguez-Castellano/Palacio (1948a; 1948b), Salvador (1957; 1977), Alarcos Llorach (1983) and, more recently, Martínez Melgar (1994), Gerfen (2002), Jiménez/Lloret (2007), and Tejada Giráldez (2012), have posited theories on the EAS phonetic and phonemic inventory. However, the perception of features of EAS by native speakers has been ignored, thus being unable to ascertain whether vowel laxing has phonemic value. García Marcos (1987), O'Neill (2010), and Torreira (2007b) are among the very few studies dedicated to speech perception in EAS, and it was this lack of perceptual studies in EAS which prompted the present paper. Perception of coda-final /s/ aspiration

or deletion has been studied in other varieties of Spanish which also exhibit this feature (e.g. Torreira 2007a, 2007b, 2012, for Western Andalusian Spanish; Hammond 1978, for Caribbean Spanish; and Figueroa 2000, for Puerto Rican Spanish), but I believe that their findings do not apply to EAS. Likewise, there has recently been intense activity in the study of Andalusian varieties (Villena Ponsoda 2000 and 2005; Hernández Campoy/Villena Ponsoda 2009; Moya Corral 2011; Melguizo Moreno 2007; Valeš 2014; and Morris 2000), but these works either focus on Western Andalusian Spanish (henceforth WAS) or on sociolinguistics and, even if they deal with phonological theory, they fail to analyse the effect of /s/, /r/, and /θ/ on neighbouring vowels.

A review of the literature (Herrero de Haro, in press a) also shows a debate regarding the correct terminology. Navarro Tomás (1938; 1939) and López Morales (1984), amongst others, use the terms *deletion* or *aspiration*, while others prefer debuccalisation (Morris 2000), but the term preferred in this paper will be *deletion*, as none of the 333 tokens analysed present aspiration. Studies such as Torreira (2007a; 2007b; 2012) present pre- and post-aspiration in /st/, /sp/, and /sk/; however, these studies focus on Western Andalusian Spanish, not on EAS (see Alvar 1973 for differences in pronunciation between Eastern and Western Andalusia). Likewise, the term *neutralisation* will also be avoided, as the perception experiment shows how not all contrasts /o/ vs /os/ vs /or/ vs /oθ/ are neutralised following consonant deletion.

The present paper is divided in 7 sections. After the introduction in Section 1, Section 2 outlines the methodology followed. Section 3 includes a brief review of literature focusing on analyses of /o/ preceding underlying consonants in EAS. In Section 4, we have a detailed study of word-final /o/ and of /o/ preceding underlying word-final /s/, /r/, and /θ/. The results for the perception test of [o], [o^{s}], [o^{r}], and [o$^{\theta}$] are discussed in Section 5. The conclusions of the study are presented in Section 6 and, finally, the bibliography is presented in Section 7.

2 Research methodology

2.1 Compilation of data

The researcher, a native speaker from El Ejido (Western Almería), visited this region of Spain in December 2013, where several speakers of EAS were recorded.

The interviewing process had two parts whenever possible: an informal interview in which trivial topics were discussed (holidays, hobbies, etc.) to create a relaxed atmosphere during the recording sessions; and a reading exercise com-

prising of a list of words and phrases containing the five Spanish vowels isolated, word-initially, word-medially, and word-finally before and after all Spanish consonants (only word-final [o], [o^{s}], [o^{r}], and [o^{ϴ}] have been analysed for this study). The speakers were friends and relatives of the author, students from local schools, and people approached in the streets. The duration of the interviews ranged from five minutes to an hour; some interviews took place at the participants' homes and others at local schools, cafés or in streets and parks. The interviewer is a native speaker from Western Almería, so the participants did not have to accommodate their accent to the one from the observer-interviewer. This contributed to the relaxed character of the interviews and helped participants feel at ease using their vernacular EAS accent. This contrasts with the situation described in Martínez Melgar (1986), where the researcher expressed concerns regarding how EAS speakers reacted to her normative Spanish accent during fieldwork interviews. The speech samples were recorded with a Zoom H2n digital recorder and they were analysed using Praat (Boersma/Weenink 2001).

At this point, it is worth defining the geographical area of study. Eastern Andalusia, as described by Jiménez Fernández (1999), Villena Ponsoda (2000), and Moya Corral (2011), amongst many others, comprises the provinces of Almería, Granada, Jaén, and Córdoba. Almería is the Easternmost province of Andalusia (in Southern Spain), and El Ejido is the biggest town in Western Almería (36km west of the border with Granada province). The present study was carried out in Western Almería but I believe that the findings also apply to Eastern Andalusian; this, however, will need to be analysed in a future study.

The table below gives some information about the participants.

Table 1: Age of participants recorded

Gender	Number of speakers	Youngest speaker	Oldest Speaker	Average age	Standard Deviation
Male	22	16	40	26 years 3 months	8.73
Female	24	16	45	21	6.99

All the speakers had a typical EAS accent from Western Almería: vowel opening preceding underlying consonants; deletion of most consonants in word-medial and word-final coda; and velarisation of word-final /n/ (a more detailed account of this geolect and differences with WAS can be found in Herrero de Haro in press a, Villena Ponsoda 2000, Valeš 2014, Moya Corral 2010 and in Jiménez Fernández 1999). All the participants have lived in El Ejido their whole life

except two of the males, who have lived in England for two and three years, albeit they still retain their EAS accent. Apart from these two males, only one of the females had a high degree of command in another language, having completed a B.A. in English.

Herrero de Haro (2016, 122, Fig. 1) adapted a version of Trudgill's (1974, 41, Fig. 2) pyramid to represent accent variation in EAS, which is included below.

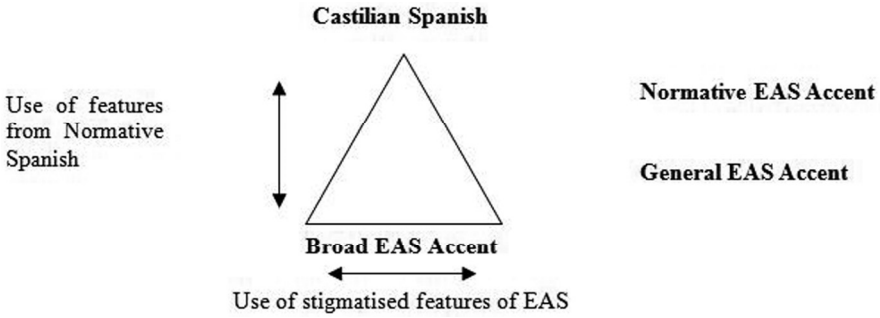

Fig. 1: Use of stigmatised EAS features and features from Normative Spanish in EAS. Taken from Herrero de Haro (2016, 122, Fig. 1).

The different types of EAS accent represented in the figure above are explained in Herrero de Haro (2016, 121s.):

> "On the top, we would have Normative Spanish, with features of Castilian Spanish only; we would then have Normative EAS, a variety with few or no uses of stigmatised features of EAS and with less frequent coda-final consonant deletion than General EAS; below, we would have General EAS, the most common form of EAS; finally, at the bottom, we would have Broad EAS, a variety characterised by the use of several stigmatised features of EAS which do not necessarily appear in General EAS (or at least not to the same degree), such as *heheo* 'pronouncing intervocalic /s/ as [h]'".

The limitation of this classification is admitted by this author (ib., 122):

> "these three categories might not be an accurate representation of the continuum found across different socio-linguistic levels of EAS speech, but they will serve the purpose of clarifying features of EAS speech to the reader".

However, a more detailed sociolinguistic study of EAS and other Andalusian varieties can be found in Villena Ponsoda (2000; 2005), Valeš (2014), and Moya Corral (2011).

It is worth noting that all speakers in the present study have a General EAS accent except a male and a female participant, who have Broad EAS accents.

Navarro Tomás (1938; 1939), Rodríguez-Castellano/Palacio (1948a), and Peñalver Castillo (2006) claim that /Θ/ and /s/ are neutralised in EAS due to either *seseo* (pronouncing /Θ/ as [s]) or *ceceo* (pronouncing /s/ as [Θ]), and that the opposition between these phonemes is also neutralised following their deletion in coda. However, the only study in which this has been tested is Herrero de Haro (2016). Navarro Tomás/Espinosa/Rodríguez Castellano (1933) already noticed a tendency for younger speakers in Western Almería to distinguish /s/ from /Θ/; this seems to be the norm now in El Ejido, as none of the 46 speakers analysed in this study present either *ceceo* or *seseo*.

2.2 Analysis of recordings

The recordings were first analysed perceptually by the researcher to determine whether or not they represented EAS accurately; indeed, all the speakers had a typical accent from El Ejido. Sanders (1998) called for a need to analyse "naturally occurring forms in free conversation" (opinion also expressed in Torreira 2012), and the free speech samples were recorded with this in mind, to capture naturally occurring speech; as such, the reading samples were excluded from the acoustic analysis to focus on natural speech as many consonants usually deleted in EAS were maintained in the reading samples. The low occurrence rate of word-final /or/ and /oθ/ in Spanish meant that there was an imbalance between tokens of [o], [o^{s}], [o^{r}], and [o^{θ}], so it was decided to adjust this. Therefore, every single token of [o^{r}] and [o^{θ}] present in each recording was analysed but tokens of [o] and [o^{s}] were analysed only in one minute of each conversation, typically between the second and third minute unless background noise or other issues prevented an accurate analysis of the fragment.

As the data analysed in this paper is from free speech, the number of tokens is lower than it would have been had we included reading samples. However, it was considered that sacrificing tokens from these reading extracts to analyse naturally occurring speech would result in far more reliable data. The number of tokens analysed are as follows:

Table 2: Number of tokens of [o], [o^{s}], [o^{r}], and [o^{θ}] analysed

Gender	[o]	[o^{s}]	[o^{r}]	[o^{θ}]	Total
Male	54	47	31	30	**162**
Female	86	39	39	7	**171**
	140	**86**	**70**	**37**	**333**

Praat (Boersma/Weenink 2001), was used to analyse [o], [o^{s}], [o^{r}], and [o$^{\theta}$] acoustically and some measures were taken to ensure consistency and accuracy of the measurements.

The F1 and F2 of /os/, /or/, and /oθ/ were only measured when the final consonant had been totally deleted, thus measuring the F1 and F2 of [o], [o^{s}], [o^{r}], and [o$^{\theta}$]. Likewise, dipthongs, triphthongs and hiatuses were discarded. F1 and F2 were measured manually on Praat (Boersma/Weenink 2001) and no script was used to ensure accuracy. The researcher listened to each conversation on Praat (ib.) and when word-final [o], [o^{s}], [o^{r}], or [o$^{\theta}$] were detected, the recording was stopped and the spectrogram of each vowel analysed. F1 and F2 were only measured during their stable section and the formants were not measured during transition. After this, the stable section of each formant was selected and then the mean F1 and F2 measurement of the selected stable section was taken using the commands *Formant*/*Get first formant* and *Formant*/*Get second formant*, as shown in Figure 2.

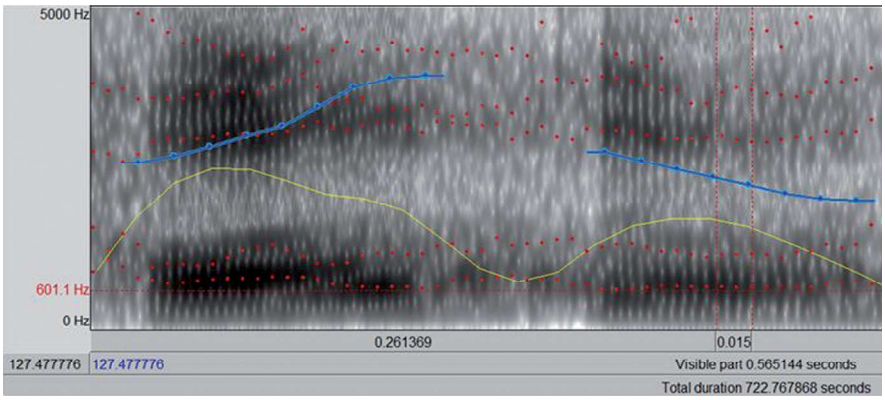

Fig. 2: Sample of selected portion of /o/ analysed in the word *fotos* ['foto^{s}].

No decimals were annotated for the formants during the acoustic analysis, instead, values were rounded up or down (e.g. *493.7* became *494*, and *1123.3* became *1123*). Following the formant analysis, the results were grouped under the categories [o], [o^{s}], [o^{r}], and [o$^{\theta}$] and then entered onto an Excel spreadsheet divided by the gender of the speaker. The F1 and F2 means were calculated for each vowel for males and females and these results, including a mean for both genders, are discussed in Section 4.

2.3 Analysis of perception experiment

A second research trip to the area took place in June 2014 to carry out a series of perception experiments. The objective was to analyse data from as many local speakers as possible, so it was decided to perform the perception experiments with students from local primary and secondary schools to gather numerous answers in a short period of time.

The researcher recorded himself reading *o*, *os*, *or* and *oz* several times in his normal accent, pronouncing them as [o], [o^{s}], [o^{r}], and [o$^{\theta}$]. The researcher listened to the recorded items and chose two examples for each vowel, choosing examples that sounded clear and not unnaturally long or short. Audacity (Team Audacity 2014) was then used to copy these items onto an audio track and numbers read by the researcher in a normative Castilian Spanish accent were recorded and added before each token, introducing the number of each question (*diez* [o], *once* [o^{r}], etc.). Each two items for each vowel were randomised and the participants heard each item twice (i.e. two [o], two [o^{s}], two [o^{r}], and two [o$^{\theta}$]). This was also done for the other four Spanish vowels; the results for /e/ are discussed in Herrero de Haro (2016) and the results for /a/, /i/, and /u/ will be discussed in following articles.

The perception test, a forced-choice task included in Appendix 1, asked each participant to choose which category each sound they heard belonged to. The answer sheet also asked the participants very limited personal information (gender, age, and hometown), and participants who had not lived in the same town since the age of four had to give additional information; answers were only analysed for those speakers who had lived in Western Almería since they were at least four years of age.

The researcher approached various primary and secondary schools in Western Almería after obtaining ethical clearance from his institution and from the Office of Education in Almería. The schools which participated in this particular experiment were a primary and secondary school from El Ejido, a secondary school from Balerma, and a secondary school from Adra. The experiments were carried out during a portion of a lesson, there was no time limit to complete the task and the students in the three secondary schools completed the perception test using an individual MP3 player and earphones per student, while the primary school group listened to the audio from the interactive board's speakers. All students heard the audio only once.

The participants were instructed to choose an answer only when they were confident of what the correct answer was. Likewise, they were instructed to leave questions blank if they could not decide which one the right answer was or if they had not heard an item well as a result of, for example, any background noise (e.g.

a classmate moving a chair). In hindsight, this raises a limitation as it was not recorded whether a blank answer is due to lack of differentiation of a sound or to background noises. To avoid this, an option for both of those cases will be added to the answer sheet in future work. However, to tackle that limitation in this paper, percentages for correct identification of each sound will be calculated including blank answers as errors and also ignoring blank answers in the count. It is important to notice, however, that out of 112 answers for each vowel, there was only 1 blank answer entered for [o], 5 for [o^{s}], 6 for [o^{r}], and 1 for [o$^{\Theta}$]. As explained in Herrero de Haro (2016), even Spanish phonemes such as /e/ and /i/ are not distinguished accurately by speakers with a 100 % accuracy, and the fact that participants left blank answers instead of guessing indicates the reliability of the answers collected.

3 Previous analyses of EAS /o/ by other researchers

3.1 The vowel /o/ in EAS and in Castilian Spanish

A look at previous studies analysing F1 and F2 values for /o/ in EAS and in CS will help determine the effect of /s/, /r/, and /Θ/ deletion on a preceding /o/ in EAS. This table contains reported values for CS /o/; values have been rounded up or down to avoid decimals.

Table 3: Formant values for Castilian [o]

Study	Type of /o/	F1	F2
Alarcos Llorach (1976)	Castilian /o/	500	1000
Quilis Morales (1981)	Castilian /o/	410	900
Quilis Morales/Esgueva (1983)	Castilian /o/ in open syllable. Male	476	900
Quilis Morales/Esgueva (1983)	Castilian /o/	475 (male)	888 (male)
		511 (female)	981 (female)
Martínez Celdrán (1984)	Castilian /o/	500	1022
Martínez Celdrán (1995)	Castilian /o/ in 20–30-year-old speakers	495 (male)	1070 (male)
		586 (female)	1201 (female)
Mean value		**494**	**995**

Those F1 and F2 values for Castilian /o/ can be compared with the values suggested for EAS /o/ from the table below; once again, values have been rounded up or down.

Table 4: Formant values for EAS [o]

Study	Type of /o/	F1	F2
Martínez Melgar (1986)	EAS /o/	502	1086
Martínez Melgar (1994)	EAS /o/	491	1194
Sanders (1994)	EAS /o/	495	1099
Sanders (1998)	Pretonic EAS /o/	482	1077
Sanders (1998)	Tonic EAS /o/	505	1120
Sanders (1998)	Word-final EAS /o/	497	1100
Corbin (2006)	EAS /o/	554	1420
Mean value		**504**	**1157**

These F1 values suggest that EAS /o/ is slightly more open than its CS counterpart. The difference in the F2 is more noticeable, with /o/ being pronounced further front in EAS than in CS. Herrero de Haro (2016) presents a similar centralisation tendency for /e/, with the mid front vowel being more open and back in EAS than in CS. This shows that EAS mid vowels tend towards centralisation when compared to CS mid vowels (also posited in Corbin 2006). This vowel opening in EAS, as opposed to CS, is what made some scholars avoid using the term *closed* when describing EAS vowels, as in Contreras Jurado's (1975) *word not affected by prosodeme of openness* vs *affected word* and Martínez Melgar's (1986) *open* vs *non-open* vowel distinction.

3.2 EAS /o/ in other contexts

Other data relevant for our study are reported measurements for EAS /o/ preceding /s/ deletion, shown below; values have been rounded up or down.

Table 5: Formant values for EAS [o^{s}]

Study	Type of /o/	F1	F2
Martínez Melgar (1986)	EAS /o/ preceding deleted /s/	515	1121
Martínez Melgar (1994)	EAS /o/ preceding deleted /s/	556	1251
Sanders (1994)	EAS /o/ preceding deleted /s/	582	1147
Sanders (1998)	Pre-tonic EAS /o/ preceding deleted /s/	579	1113
Sanders (1998)	Tonic EAS /o/ preceding deleted /s/	602	1180
Sanders (1998)	Word-final EAS /o/ preceding deleted /s/	565	1148
Corbin (2006)	EAS /o/ preceding deleted /s/	630	1390
Mean value		**576**	**1193**

Martínez Melgar (1986; 1994) and Sanders (1994; 1998) indicate a slight increase in the F2 of EAS /o/ when it precedes deleted /s/, although Corbin (2006) suggests the opposite. However, the three authors agree on a clear opening of /o/ when it precedes deleted /s/. Once again, /o/ follows the same tendency presented by these authors for [e] vs [e^{s}], with /e/ displaying opening when it precedes underlying /s/ but without any real difference between the F2 of [e] and [e^{s}].

Corbin (2006) also reports F1 and F2 values for three types of realisations of /o/: [os] (F1 584, F2 1580); [oh] (F1 618, F2 1360); and [o^{s}] (F1 708, F2 1330). As it was also reported for /e/ in Corbin (2006), /o/ is more open when it precedes /s/ deletion than when /s/ is preserved and the realisation of /s/ as [h] presents intermediate values.

4 Acoustic analysis of EAS /o/

4.1 Word-final /o/ in EAS

An analysis of free speech word-final /o/ in the recordings yielded the following values in the present study.

Table 6: F1 and F2 values for word-final /o/ in EAS

Word-final /o/ in EAS					
Gender	**F1**	**F2**	**Stan Dev F1**	**Stan Dev F2**	**Tokens**
Male	496	1224	39.64	214.01	54
Female	485	1205	44.66	245.24	86
Both	489	1212	42.98	233.08	140

The data in the table above show that F1 and F2 values are consistent within males and females from El Ejido. The values obtained for F1 match those reported in Table 3 and 4, although F2 values match those obtained for EAS /o/ (Table 4) much closer than the ones obtained for CS /o/ (Table 3). Despite this, it is worth bearing in mind that the studies referred to in Table 4 analysed the speech from other areas where EAS is spoken, not from Almería.

4.2 /o/ preceding deleted /s/ in EAS

As in 4.1, the data presented below correspond to F1 and F2 values obtained from free speech samples, as encouraged by Sanders (1998).

Table 7: F1 and F2 values for EAS /o/ preceding underlying word-final /s/

/o/ preceding deleted word-final /s/ in EAS					
Gender	**F1**	**F2**	**Stan Dev F1**	**Stan Dev F2**	**Tokens**
Male	591	1234	44.7	215.19	47
Female	583	1246	73.67	258.42	39
Both	587	1239	59.35	234.24	86

Once again, F1 and F2 measurements are consistent between both groups of speakers. The values in Table 7 are in line with those from Table 5; EAS /o/ clearly opens when it precedes an underlying /s/ and it also suffers a slight fronting. Thus, we can appreciate that there is a consistent difference of quality between [o] and [o^{s}] in EAS.

As it was argued in Herrero de Haro (2016) for /e/, this opening of /o/ preceding underlying /s/ matches the results presented in Navarro Tomás (1938; 1939), Alonso/Zamora Vicente/Canellada de Zamora (1950), Alvar (1955; 1973), Salvador (1957; 1977), Gómez Asensio (1977), Zubizarreta (1979), López Morales

(1984), Martínez Melgar (1986; 1994), Sanders (1998), and Peñalver Castillo (2006).

López Morales (1984) and Martínez Melgar (1986) considered EAS vowel opening a phonetic feature with no phonological value; however, this has not been tested yet; an analysis of the data obtained during the perception experiment will establish whether this is the case, at least in Western Almería.

4.3 /o/ preceding deleted /r/ in EAS

As in previous cases, the vowel [o^{r}] was analysed in the speech of 46 participants. The table below presents the data obtained.

Table 8: F1 and F2 values for EAS /o/ preceding underlying /r/

/o/ preceding deleted word-final /r/ in EAS					
Gender	**F1**	**F2**	**Stan Dev F1**	**Stan Dev F2**	**Tokens**
Male	627	1209	58.89	206.5	31
Female	647	1309	71.75	227.91	39
Both	638	1265	66.7	222.86	70

As explained in Herrero de Haro (2016), there is no previous acoustic data available for vowels preceding underlying /r/, so no comparison with previous studies is possible. However, it is worth considering the impressionistic analysis of Navarro Tomás (1938; 1939), who claimed that vowels preceding deleted /r/ were open but not as open as vowels preceding deleted /s/.

The measurements obtained for [o^{r}] in the present study are consistent for males and females, with females presenting a higher F2. Both, males and females, present higher F1 and F2 values for [o^{r}] than for [o^{s}], contradicting Navarro Tomás' (1938; 1939) impressionistic analysis. F2 values, however, differ between males and females, with males presenting a lower F2 for [o^{r}] than for [o] and [o^{s}] and with females presenting a higher F2 for [o^{r}] than for [o] and [o^{s}]. Despite the more irregular pattern of the F2, this difference in value between the F1 and the F2 of [o^{s}] and [o^{r}] indicates that EAS /o/ has a different quality before underlying /s/ and underlying /r/.This has never been demonstrated before.

The perception test in Section 5 will help establish whether EAS speakers can differentiate between /o/ preceding deleted /s/ and /o/ preceding deleted /r/. It is worth pointing out that data from a similar experiment reported in Herrero de

Haro (2016) for the vowel /e/ showed that EAS speakers from Western Almería can, indeed, differentiate [e^{s}] from [e^{r}].

4.4 /o/ preceding deleted /θ/ in EAS

It was originally planned to analyse [o$^{\theta}$] using only free speech samples, but the much lower occurrence rate in Spanish of /oθ/ as opposed to /o/, /os/, or /or/ meant that a different approach was needed. Consequently, it was decided to analyse [o$^{\theta}$] in the reading extracts as well, although only words in which [θ] had been completely deleted were analysed. These words were first analysed perceptually by the researcher and only words that sounded like natural EAS speech were included in the analysis, i.e. words free from normative pronunciation features. There were 13 instances of [o$^{\Theta}$] in the reading samples of males and five in the samples from females and the values obtained from those measurements were added to the ones obtained from 17 examples of [o$^{\Theta}$] in the free conversations with males and two from the free conversations with females. It is worth pointing out, however, that the measurements from [o$^{\Theta}$] obtained from the free conversation samples and from the reading samples present similar F1 and F2 values.

Table 9: F1 and F2 values for EAS /o/ preceding underlying /θ/

/o/ preceding deleted word-final /θ/ in EAS					
Gender	**F1**	**F2**	**Stan Dev F1**	**Stan Dev F2**	**Tokens**
Male	607	1106	60.71	119.4	30
Female	604	1129	74.28	191.88	7
Both	607[1]	1110	62.37	133.08	37

Once again, the results obtained for [o$^{\theta}$] are consistent for males and females. It is important to notice that both F1 and F2 for males and females present a similar relation to the values obtained for [o], [o^{s}], and [o^{r}]. That is, for males and females, F1 values for [o$^{\Theta}$] are higher than for [o] and [o^{s}] but lower than for [o^{r}]. Likewise, F2 values for males and females are lower for [o$^{\Theta}$] than for [o], [o^{s}], and [o^{r}]. Interestingly, values reported for /e/ in Herrero de Haro (2016) also show an

1 Rounded up and down results and the fact that there are 30 examples of [o$^{\Theta}$] for males and 7 for females is what causes the mean for both groups to be the same as the mean for males.

identical tendency; F1 is higher for [e$^{\Theta}$] than for [e] and [e^{s}], but lower than for [e^{r}], and F2 is lower for [e$^{\Theta}$] than for [e], [e^{s}], and [e^{r}].

An analysis of the F1 and F2 of /o/ preceding underlying /θ/ shows that [o$^{\theta}$] has different F1 and F2 values to [o], [o^{s}], and [o^{r}]. The results presented thus far call for the need to consider these four vowels as four different allophones of /o/; a perception test will help establish whether word-final [o$^{\theta}$] has phonetic or phonemic value in EAS.

As explained in Herrero de Haro (in press a), Alvar (1973, maps 1613, 1620 and 1625) analysed the Spanish words *zagal*, *mar* and *más* and concluded that the deletion of word-final /l/, /r/, and /s/ caused different changes in the quality of a preceding /a/ in some towns, as in Berja (Al507). Likewise, Alvar (1973, maps 1626 and 1629) also showed that in towns such as Algarinejo (Gr303), Escúzar (Gr503), and Alboloduy (Al501), /s/ and /θ/ deletion cause a different degree of opening on a preceding /o/, causing a different change of quality in the vowels of the words *tos* and *voz*. Navarro Tomás (1938) and Jiménez/Lloret (2007) also posited that /l/ and /r/ deletion causes a lower degree of opening on a preceding vowel than /s/ deletion, although Herrero de Haro (2016) and the present study show the opposite for /e/ and /o/, at least when they precede deleted /r/. According to Herrero de Haro (2016; in press a), these are the only works in EAS literature which analyse the role of vowel quality in marking the functional load of a deleted coda-final consonant other than /s/. Despite these findings, Herrero de Haro (2016) is the only study to examine if the opening of /e/ caused by /r/ deletion has distinctive value.

4.5 Formant values for [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] in EAS

It is worth reviewing the conclusions reached for /e/ in Herrero de Haro (2016) before analysing the data obtained for EAS [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] in the present study. Herrero de Haro (2016) presents the following values for [e], [e^{s}], [e^{r}], and [e$^{\Theta}$].

Table 10: F1 and F2 values for word-final /e/ and for /e/ preceding underlying word-final /s/, /r/ and /θ/ in EAS. Taken from Herrero de Haro (2016)

Participant	[e]		[e^{s}]		[e^{r}]		[e$^{\Theta}$]	
	F1	F2	F1	F2	F1	F2	F1	F2
F29E	456	2091	611	1959	652	1847	616	2054
F31E	473	2117	580	1867	630	1937	582	1658
M31E	484	2064	597	1736	603	1800	632	1675
M34E	481	1919	601	1649	677	1734	579	1535
Mean	**473.5**	**2047.75**	**597.25**	**1802.75**	**640.5**	**1829.5**	**602.25**	**1730.5**
Standard Dev.	**12.55**	**88.51**	**12.91**	**137.04**	**31.52**	**85.34**	**25.97**	**224.50**

The figure below illustrates the quality of the four vowels.

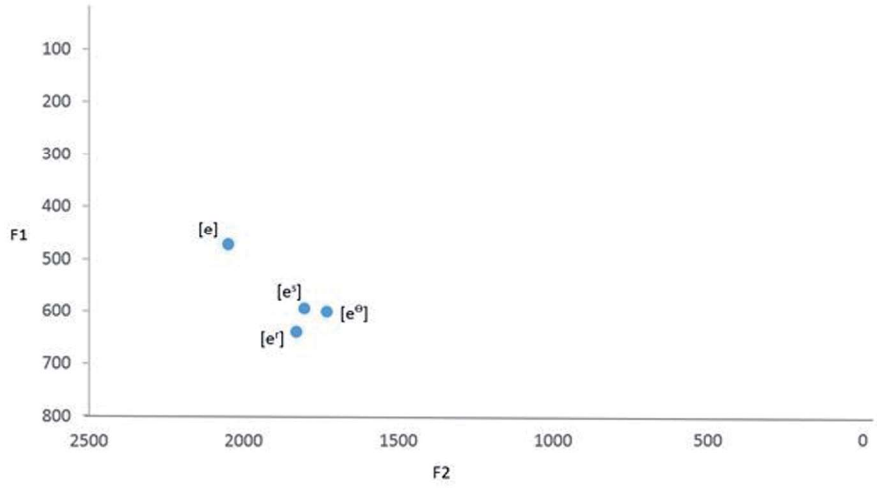

Fig. 3: Mean values obtained for [e], [e^{s}], [e^{r}], and [e$^{\Theta}$] in EAS. Taken from Herrero de Haro (2016).

Herrero de Haro (in press a) explains how EAS studies have mainly focused on the effect of /s/ deletion on preceding vowels, ignoring the effects of deleting other consonants. The table below summarises the values obtained for /o/ in word-final position and when it precedes underlying word-final /s/, /r/, and /Θ/.

Table 11: F1 and F2 values for EAS word-final [o], [o^{s}], [o^{r}], and [o$^{\Theta}$]

Type of EAS /o/	Gender	F1	F2	Stan Dev F1	Stan Dev F2	Tokens
Word-final [o]	Male	496	1224	39.64	214.01	54
	Female	485	1205	44.66	245.24	86
	Both	489	1212	42.98	233.08	140
Word-final [o^{s}]	Male	591	1234	44.7	215.19	47
	Female	583	1246	73.67	258.42	39
	Both	587	1239	59.35	234.24	86
Word-final [o^{r}]	Male	627	1209	58.89	206.5	31
	Female	647	1309	71.75	227.91	39
	Both	638	1265	66.7	222.86	70
Word-final [o$^{\Theta}$]	Male	607	1106	60.71	119.4	30
	Female	604	1129	74.28	191.88	7
	Both	607	1110	62.37	133.08	37

The table above shows how F1 and F2 values for [o] differ from the values of [o^{s}], [o^{r}], and [o$^{\Theta}$]. Similarly to what Herrero de Haro (2016) reported for /e/, in EAS, at least in the town of El Ejido, [o] has a lower F1 than [o^{s}], [o^{r}], and [o$^{\Theta}$]. The difference between these four types of /o/ could be explained using two types of distinctions: 1) a primary distinction in F1 values between word-final /o/ and /o/ followed by underlying word-final /s/, /r/, and /Θ/, as F1 is much lower for [o] than for [o^{s}], [o^{r}], and [o$^{\Theta}$]; 2) a secondary distinction in F1 values for /o/ depending on the following underlying consonant (/s/, /r/, or /Θ/), as the F1 values of [o^{s}], [o^{r}], and [o$^{\Theta}$] are quite close to each other, especially compared to [o].

In contrast, the relationship between F2 values for [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] is not as straightforward. For both, male and female speakers, [o$^{\Theta}$] presents the lowest F2 and [o] has a lower F2 than [o^{s}]; however, F2 values for male [o^{r}] is between the values obtained for [o$^{\Theta}$] and [o], while female [o^{r}] is the allophone of /o/ with the highest F2 value. Once again, [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] F1 values are more consistent than those obtained for F2, which is in line with the data reported in Herrero de Haro (2016) for /e/. This might also show that F1 is more reliable than F2 when it comes to distinguishing between [o], [o^{s}], [o^{r}], and [o$^{\Theta}$], as Corbin (2006) suggested for the contrast /V/ vs /V^{s}/.

Given the consistency between the F1 and F2 values obtained for all our speakers, it can be asserted that EAS /o/, at least in the town of El Ejido, has four allophones: [o], [o^{s}], [o^{r}], and [o$^{\Theta}$]. A perception test with speakers from Western Almería will help clarify whether these four vowels have phonetic or *some*

phonological value in this geolect; however, given the acoustic differences found between these four vowels, it can be predicted that distinguishing [o] from [o^{s}], [o^{r}], and [o$^{\Theta}$] will be easier than distinguishing between [o^{s}], [o$^{r\cdot}$], and [o$^{\Theta}$]. The graphs below illustrate the difference between these vowels.[2]

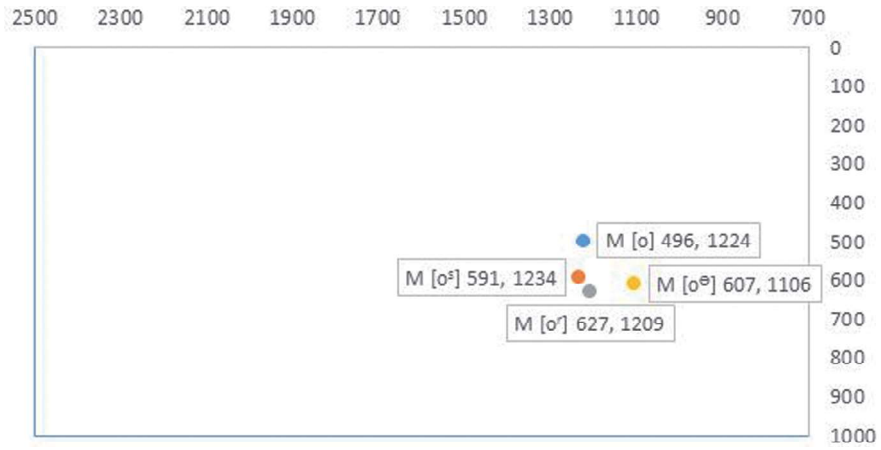

Fig. 4: Mean values obtained for [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] in male speakers from El Ejido.

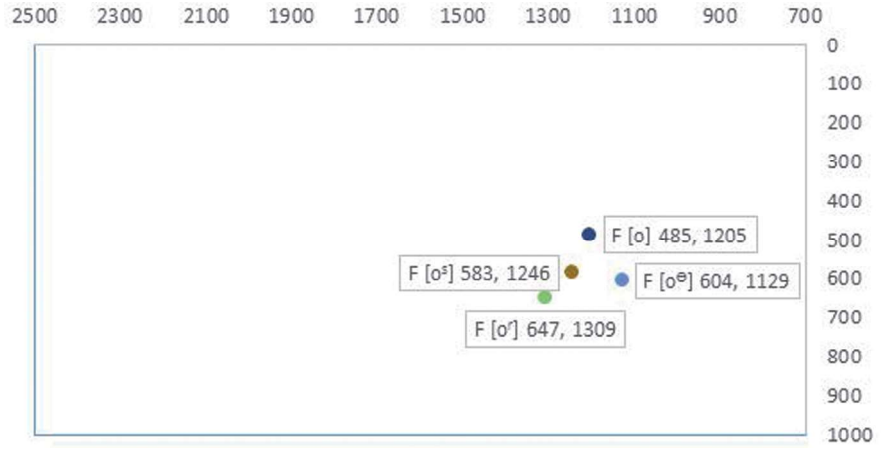

Fig. 5: Mean values obtained for [o], [o^{s}], [o^{r}], and [o$^{\Theta}$] in female speakers from El Ejido.

2 The numbers next to each vowel are the values for F1 and for F2, respectively.

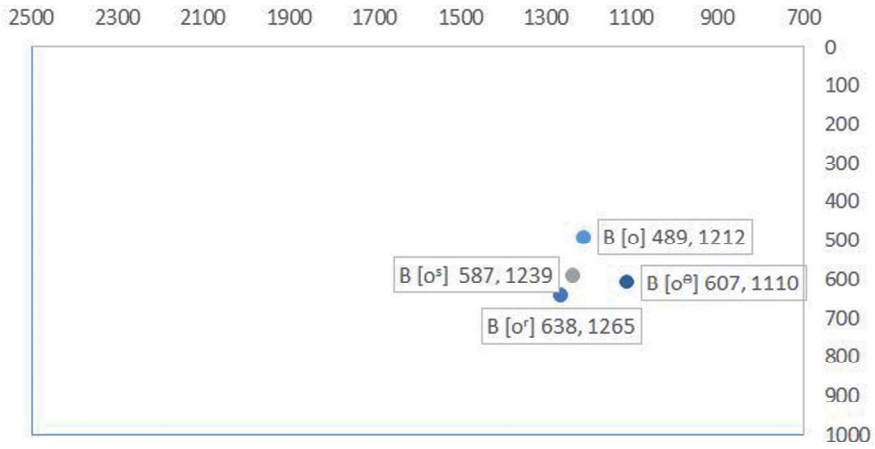

Fig. 6: Mean values obtained for [o], [oˢ], [oʳ], and [oᵉ] in male and female speakers from El Ejido.

Herrero de Haro (in press a) stresses that various researchers, such as Martínez Melgar (1986; 1994) and Sanders (1998), have only studied differences between [o] and [oˢ]. The vowels preceding underlying /r/ or /ɵ/ have not been analysed before, with the present study being the first one to describe these four realisations of /o/ in EAS. Furthermore, scholars have focused almost exclusively on production rather than on perception, which is why Gerfen/Hall (2001) and Bishop (2007) call for more perception studies; this is what prompted the design of the second part of the present paper. Its aim is to analyse whether speakers from Western Almería can distinguish between those four mid back vowels. This would help establish whether [o], [oˢ], [oʳ], and [oᵉ] are allophones of /o/ and whether they have phonemic value, although a detailed phonological study is needed before they can be considered full phonemes.

5 Perception of /o/

Herrero de Haro (2016; in press a) shows how previous EAS studies have examined this geolect only from the point of view of production, ignoring perceptual elements in native speaker. This section is designed to clarify this, analysing data from a perception experiment to help establish whether vowel quality differences between [o], [oˢ], [oʳ], and [oᵉ] are only of a phonetic nature or whether EAS speakers can, in fact, differentiate between them.

5.1 Perception experiment: [o] vs [o^{s}] vs [o^{r}] vs [o$^{\Theta}$]

This experiment focuses on the contrasts between the four allophones of /o/ presented in Section 4.5: [o], [o^{s}], [o^{r}], and [o$^{\Theta}$]. The participants in the perception experiment were given an individual MP3 player and earphones each with the audio (except the primary school group) and an answer sheet (Appendix 1).

The respondents then listened to the track and marked the option they heard in each case: [o], [o^{s}], [o^{r}], or [o$^{\Theta}$]. The data obtained for /o/ is reported below, the data for /e/ was reported in Herrero de Haro (2016), and the data for /a/, /i/ and /u/ will be analysed in future articles.

5.2 Analysis of answers from the perception experiment

A forced-choice perception experiment was administered in which the respondents had to decide which category each sound belonged to. The participants were students from a primary school in El Ejido and from three secondary schools, one located in El Ejido, another one in Balerma, and the third one in Adra. The three towns are in Western Almería: Adra is furthest west in Western Almería, next to the border with Granada province; Balerma is 16 km East of Adra; El Ejido is 21 km East from Adra and 10 km from Balerma.

The tables below summarise the results obtained from the perception experiment. Each item [o], [o^{s}], [o^{r}], or [o$^{\Theta}$] appeared twice in the perception experiment, which is why the number of answers is double the amount of respondents.

Table 12: Answers to the perception experiment by 14- and 15-year olds from El Ejido

	[o]	[o^{s}]	[o^{r}]	[o$^{\Theta}$]
Answers	34	34	34	34
Blank answer	1 (2.94 %)	2 (5.88 %)	1 (2.94 %)	1 (2.94 %)
Correct answers (counting blank answers as errors)	33/34 (97.05 %)	12/34 (35.29 %)	7/34 (20.58 %)	14/34 (41.17 %)
Correct answers (discarding blank answers)	33/33 (100 %)	12/32 (37.5 %)	7/33 (21.21 %)	14/33 (42.42.%)
Number of respondents	17	17	17	17

The table below presents perception data from Adra:

Table 13: Answers to the perception experiment by 15- and 16-year olds from Adra

	[o]	[o^{s}]	[o^{r}]	[o$^{\Theta}$]
Answers	14	14	14	14
Blank answer	0	0	0	0
Correct answers (counting blank answers as errors)	13/14 (92.85 %)	0/14 (0 %)	2/14 (14.28 %)	3/14 (21.42 %)
Correct answers (discarding blank answers)	N/A	N/A	N/A	N/A
Number of respondents	**7**	**7**	**7**	**7**

The table below presents perception data from Balerma:

Table 14: Answers to the perception experiment by 15- and 16-year olds from Balerma

	[o]	[o^{s}]	[o^{r}]	[o$^{\Theta}$]
Answers	24	24	24	24
Blank answer	0	0	1 (4.16 %)	0
Correct answers (counting blank answers as errors)	23/24 (95.83 %)	5/24 (20.83 %)	2/24 (8.33 %)	10/24 (41.66 %)
Correct answers (discarding blank answers)	N/A	N/A	2/23 (8.69 %)	N/A
Number of respondents	12	12	12	12

The following table presents the results obtained from primary school participants; however, this group listened to the stimuli being played out of the interactive board's speakers as the MP3 players were not available yet when this group was tested.

Table 15: Answers to the perception experiment by 11- and 12-year olds from El Ejido

	[o]	[o^{s}]	[o^{r}]	[o$^{\theta}$]
Answers	40	40	40	40
Blank answer	0	3 (7.5 %)	4 (10 %)	0
Correct answers (counting blank answers as errors)	38/40 (95 %)	11/40 (27.5 %)	14/40 (35 %)	14/40 (35 %)
Correct answers (discarding blank answers)	N/A	11/38 (31.57 %)	14/35 (40 %)	N/A
Number of respondents	20	20	20	20

The following table summarises perception results for the four groups of participants, offering combined percentages for all groups.

Table 16: Overall results from the perception experiment for the four groups

	[o]	[o^{s}]	[o^{r}]	[o$^{\theta}$]	Total
Answers	112	112	112	112	448
Blank answer	1	5	6	1	13 (2.9 %)
Correct answers (counting blank answers as errors)	107/112 (95.54 %)	28/112 (25 %)	25/112 (22.32 %)	41/112 (36.61 %)	201/448 (44.86 %)
Correct answers (discarding blank answers)	107/111 (96.39 %)	28/107 (26.16 %)	25/106 (23.58 %)	41/111 (36.94 %)	201/435 (45.16 %)
Number of respondents	56	56	56	56	56

As presented in Table 12 to 15, when it came to identifying [o], [o^{s}], and [o$^{\theta}$], the secondary school groups from El Ejido and Balerma (who listened to the stimuli on the MP3 players) did better than the primary school group from El Ejido (who listened to the stimuli on the interactive board's speakers). However, the primary school group outperformed all secondary school groups when it came to identifying [o^{r}], which indicates that the medium in which the perception test was administered did not have an impact on the accuracy of the responses. On the other hand, the primary school group submitted 4.37 % of blank answers, which was higher than the percentage of blank answers submitted by the groups who used the MP3s: 3.67 % for the group from El Ejido; 1.04 % for the group from Balerma; and 0 % for the group from Adra. The overall results for the four groups add up to a total of 97.27 % of correct identification for [o], 25.93 % for [o^{s}], 23.58 % for [o^{r}], and 36.94 % for [o$^{\theta}$].

Regarding [o], the 97.27 % of correct identification is statistically significant (p-value < 0.0001) (all statistical analyses carried out on Graphpad Software). This shows that the correct differentiation of [o] from [o^{s}], [o^{r}], and [o^{ϴ}] is not due to chance. Furthermore, out of the 325 answers submitted for [o^{s}], [o^{r}], or [o^{ϴ}], 231 were errors, and out of all those incorrect answers, only 15 were submitted under [o]. This means that EAS speakers very rarely confuse [o^{s}], [o^{r}] and [o^{ϴ}] with [o] (p-value < 0.0001), suggesting that they can distinguish effectively between [o] (*unaltered* /o/) and [o] followed by a deleted consonant (*altered* /o/), as Herrero de Haro (2016) posited for /e/. There is strong evidence of opening of /o/ and /e/ preceding an underlying /s/ (Martínez Melgar 1986; Sanders 1998) or underlying /r/ or /ϴ/ (Alvar 1973; Herrero de Haro 2016); however, the distinctive feature differentiating *unaltered* from *altered* vowels remains unidentified. It has not been demonstrated whether the distinctive feature in this contrast is the same one posited for other varieties of Spanish, such as vowel lengthening for Miami-Cuban Spanish (Hammond 1978) and for Puerto Rican Spanish (Figueroa 2000), or post-aspiration of /t/ in /st/ in Western Andalusian Spanish (Torreira 2007; Ruch/ Harrington 2014).

In the case of EAS, this distinctive feature could be of a suprasegmental nature. These findings are in line with what Contreras Jurado (1975) defined as *word not affected by prosodeme of openness* vs *affected word* distinction and with what Martínez Melgar (1986) described as *non-open* and *open* vowels. The acoustic data presented in the present paper support Contreras Jurado's (1975) and Martínez Melgar's (1986) distinctions; however, a closer analysis of the perception results for [o^{s}], [o^{r}], or [o^{ϴ}] suggests that EAS speakers can distinguish further contrasts than previously thought.

With respect to [o^{s}], the correct identification of 25.93 % is not statistically significant (p-value = 0.2348), thus we can conclude that EAS speakers cannot distinguish [o^{s}] from [o^{r}], or [o^{ϴ}]. Likewise, when it came to identifying [o^{r}], the total percentage of correct identification was 23.58 %; this is not statistically significant either (p-value = 0.7365), which shows that EAS speakers cannot differentiate [o^{r}] from [o^{s}] or [o^{ϴ}]. However, [o^{θ}] was correctly identified at a rate of 36.94 % and this distinction is statistically significant (p-value = 0.0037), which means that EAS speakers, at least in Western Almería, can differentiate [o^{ϴ}] from [o], [o^{s}], and [o^{r}].

The perception experiment in this paper shows that EAS speakers can distinguish one type of mid back vowel ([o^{θ}]) when a consonant is deleted, as opposed to the two types of mid front vowels ([e^{s}] and [e^{r}]) that these speakers can distinguish (Herrero de Haro 2016). According to Alarcos Llorach (1976, 198), 12.6 % of Spanish sounds are /e/ while 10.3 % are /o/, and the higher frequency of /e/ could explain why EAS speakers differentiate more types of /e/ than of /o/.

Ohala (2008, 32) explains a similar process: "In every given language, more frequent sounds are mastered earlier". Vásquez (1953) also used this principle to explain why /a/, /e/, and /o/ double in Uruguayan Spanish following /s/ deletion but /i/ and /u/ do not.

5.3 Perception experiment: results discussion

The results from the perception experiment show that EAS speakers can distinguish between *unaltered* /o/ ([o]) and *altered* /o/ ([o^{s}], [o^{r}] and [o$^{\Theta}$]), what could be referred to as a primary distinction between these mid back vowels. Furthermore, a secondary distinction between mid back vowels could also be posited based on the fact that, apart from the aforementioned primary distinction, EAS speakers have shown the ability to distinguish [o$^{\Theta}$] from [o], [o^{s}], and [o^{r}] at a much higher rate than chance level, as supported by statistical analyses. These distinctions are similar to the ones reported in Herrero de Haro (2016) for /e/, although EAS speakers have shown an ability to differentiate two types of *altered* mid front vowels ([e^{s}] from [e], [e^{r}], and [e$^{\theta}$]; and [e^{r}] from [e], [e^{s}], and [e$^{\theta}$]), while they can only distinguish one type of *altered* mid back vowel ([o$^{\Theta}$] from [o], [o^{s}], and [o^{r}]). Given the low rate of occurrence of /oΘ/, it seems strange that EAS speakers can distinguish [o$^{\theta}$] from [o^{s}] and [o^{r}], but not [o^{s}] or [o^{r}] from other *altered* vowels. The acoustic analysis conducted in Section 4 showed small difference in the F1 of [o^{s}], [o^{r}], and [o$^{\theta}$]. Likewise, the F2 values for [o], [o^{s}], and [o^{r}] were also close; however, F2 values for [o$^{\theta}$] were consistently much lower than for the other three mid back vowels, and it is possible that EAS speakers use this to identify [o$^{\Theta}$]. This, however, needs further analysis.

Taking into account the results from the perception experiment, it can be concluded that EAS speakers can differentiate /o/ from /o/ preceding underlying /s/, /r/, or /θ/ with a rate of accuracy of 97.27 % (95.54 % if we count blank answers as errors). Furthermore, native speakers of EAS, at least the ones from Western Almería, can differentiate the mid back vowel [o$^{\Theta}$] from [o], [o^{s}], and [o^{r}]; p-values back both of these assertions. Considering all this, the well-researched [o] vs [o^{s}] contrast analysed by several scholars (e.g. Martínez Melgar 1986; 1994; Sanders 1998), might be, as Navarro Tomás (1939) said, not based on identifying the exact properties of [o^{s}], but on identifying that a consonant has been deleted. Thus, when faced with the [o] vs [o^{s}] contrast, EAS speakers can differentiate these as they can perceive an underlying consonant in the latter case.

6 Conclusion

The initial question was whether the deletion of word-final /s/, /r/, and /θ/ causes different changes in the preceding /o/ and whether these changes are consistent. An acoustic analysis of 333 tokens from 46 speakers demonstrate that, indeed, the deletion of these three consonants causes changes on a preceding /o/. As a results, EAS has, at least, four allophones of /o/ word-finally: /o/ ([o]); /o/ preceding underlying /s/ ([o^{s}]); /o/ preceding underlying /r/ ([o^{r}]); and /o/ preceding underlying /θ/ ([o^{θ}]). These allophones of /o/ present consistent values in the analysed samples. It could be argued that it is necessary to analyse more than 333 tokens of /o/; however, the fact that the majority of these 333 tokens were obtained from naturally occurring speech shows the reliability of these samples. Even though it would be highly beneficial to increase the amount of tokens in future studies, the conclusions reached thus far should be accepted as a starting point, as this is the first attempt to quantify the effects of consonant deletion other than /s/ on /o/.

The data obtained present consistent values in the F1 and F2 of [o], [o^{s}], [o^{r}] and [o^{θ}] across 46 speakers, (males and females), with F1 showing a more consistent pattern than F2. These results are in line with what was reported for /e/ in Herrero de Haro (2016).

Furthermore, this article has also studied the perception of word-final /o/ and of /o/ followed by underlying /s/, /r/, and /θ/. The results from the perception experiment show that EAS speakers from Western Almería can distinguish between *unaltered*/*non-open* /o/ and *altered*/*open* /o/ without contextual help, which contradicts the theories posited by Contreras Jurado (1975) and by López Morales (1984), amongst others. In addition to this primary distinction between *unaltered*/*non-open* /o/ and *altered*/*open* /o/, EAS speakers can also distinguish [o^{θ}] from [o], [o^{s}] and [o^{r}], most likely due to the low F2 of [o^{θ}], although this needs to be analysed in more detail.

This distinctions between *unaltered*/*non-open* /o/ and *altered*/*open* /o/ is similar to the one posited for /e/ in Herrero de Haro (2016); the ability to distinguish [o^{θ}] from [o], [o^{s}], and [o^{r}] is also similar to the one reported in the aforesaid article, in which EAS speakers were able to distinguish [e^{s}] from [e], [e^{r}], and [e^{θ}]; and [e^{r}] from [e], [e^{s}], and [e^{θ}].

Alvar (1973) already identified different types of /o/ preceding the deletion of different consonants. However, the present paper represents the first attempt to quantify these differences and to analyse perception of /o/ following different consonant deletion.

I believe that the distinction described for /o/ does not only operate word-finally, but also word-internally. At the same time, I suspect that, as it has been now demonstrated for /e/ and /o/, there is a similar phonetic distinction for /a/,

/i/ and /u/ preceding the deletion of different consonants. These two aspects still remain to be analysed in future studies; however, in the meantime, it can be concluded that: 1) in EAS, /s/, /r/, and /θ/ deletion cause different types of alterations on a preceding /o/, thus creating [o^{s}], [o^{r}], and [o^{θ}]; 2) EAS speakers can differentiate, on the one hand, between word-final /o/ and /o/ followed by underlying word-final /s/, /r/, and /θ/, and on the other, they can differentiate [o^{θ}] from [o], [o^{s}], and [o^{r}]; and 3) the EAS [o] vs [o^{s}] contrast is not based on identifying the quality of [o^{s}], but on identifying an underlying consonant.

7 References

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Appendix

Hoja de respuestas. Experimento 0

Datos personales: Hombre Mujer
Edad: _____
¿En qué pueblo vives? _____
Si no has vivido en ese pueblo **desde que tienes 4 años**, di en qué pueblo vivías antes y cuánto tiempo llevas en el pueblo en el que vives ahora: _____

Señala con un círculo la respuesta correcta. Si cometes un error, tacha la respuesta incorrecta y señala con un círculo la respuesta correcta.

1	a	as	ar	az
2	a	as	ar	az
3	a	as	ar	az
4	a	as	ar	az
5	a	as	ar	az
6	a	as	ar	az
7	a	as	ar	az
8	a	as	ar	az
9	e	es	er	ez
10	e	es	er	ez
11	e	es	er	ez
12	e	es	er	ez
13	e	es	er	ez
14	e	es	er	ez
15	e	es	er	ez
16	e	es	er	ez

Hoja de respuestas. Experimento 0

17	i	is	ir	iz
18	i	is	ir	iz
19	i	is	ir	iz
20	i	is	ir	iz
21	i	is	ir	iz
22	i	is	ir	iz
23	i	is	ir	iz
24	i	is	ir	iz
25	o	os	or	oz
26	o	os	or	oz
27	o	os	or	oz
28	o	os	or	oz
29	o	os	or	oz
30	o	os	or	oz
31	o	os	or	oz
32	o	os	or	oz
33	u	us	ur	uz
34	u	us	ur	uz
35	u	us	ur	uz
36	u	us	ur	uz
37	u	us	ur	uz
38	u	us	ur	uz
39	u	us	ur	uz
40	u	us	ur	uz