

The Eastern Andalusian vowel system: Form and structure

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The laxing of vowels in plural nouns and certain verbal forms in Eastern Andalusian Spanish is an example of a contextually induced complication of a vowel system. The alternation has been as open/closed or tense/lax. The claimed vowel inventory varies from eight to ten, largely due to the difficulty of determining the status of the high vowels. The principal objective of the current study is to provide a new data set taken from native speakers that will be sufficient to outline the inventory and distribution of the Eastern Andalusian vowel phones. The basic problem at the descriptive level is to determine if Eastern Andalusian laxing is truly systematic and to what degree. This new phonetic survey is based on a sampling taken from a selected group of speakers who clearly manifest the phenomenon. These data provided the basis for my doctoral thesis Sanders (1994).

1. Introduction

The vowel systems of languages differ in their phonemic inventories and contrastive features. The phonetic realizations of the phonemic vowel inventory depend on a variety of factors involving the overall phonological and morphological organization of a given language. These factors may serve to reduce or multiply the overall complexity of the vowel system. The laxing of vowels in plural nouns and certain verbal forms in Eastern Andalusian Spanish is an example of a contextually induced complication of a vowel system. Investigators such as Navarro Tomás (1939), Alonso et al. (1950), Salvador (1957, 1977) and others claim that the phonemic vowel inventory of Eastern Andalusian has "doubled" (*desdoblamiento*) from the five of standard Spanish to as many as ten. The trigger for vowel doubling is generally taken to be the aspiration or deletion of word-final /s/, which serves as the plural marker and is also present in several common verbal inflections. The aspiration or elision of word-final /s/ opens or laxes the adjacent vowel. The alternation has been variously described as *open/closed* and *tense/lax*. The claimed vowel inventory varies from eight to ten, largely due to the difficulty of determining the status of the high vowels.

The *desdoblamiento* analysis is based on the observation that native speakers of Eastern Andalusian can distinguish minimal pairs according to vowel quality. The minimal pair sg. *beso* 'kiss' and pl.

besos 'kisses' can be distinguished by native speakers of Eastern Andalusian according to the alternation of open and closed vowels. The ability to discern a semantic contrast obtains even with the deletion of the plural marker word-final /s/. In the typical pronunciation of the region the final /s/ is not pronounced in *besos*, but the vowels are more open than in the corresponding singular form. Proponents of *desdoblamiento* claim that the tense/lax alternation is phonemic because minimal pairs can be distinguished based on one position, as is the common practice for determining the vowel inventory of any given language.

Recent phonetic descriptions (Martínez Melgar 1986 and Llisterri & Poch 1987) have raised questions regarding the observations of earlier investigators, such as Alonso et al. (1950). These recent instrumental studies suggest that the degree of the tense/lax alternation does not support the *desdoblamiento* analysis. Martínez Melgar found little evidence of systematic vowel alternations. Llisterri & Poch indicate that the tense/lax alternation is limited to tonic and word-final mid-vowels. Significantly, they found limited evidence of the distinctive palatal [a] regularly reported in the impressionistic data collected by experienced investigators such as Navarro Tomás, Alonso et al. and Salvador.

Although there have been numerous studies of the Eastern Andalusian vowel system and the observed process of *desdoblamiento*, I believe that none of these studies has provided sufficient data for a complete analysis; the organization of the Eastern Andalusian vowel system therefore remains unclear. The principal objective of the current study is to provide a new data set taken from native speakers that will be sufficient to outline the inventory and distribution of vowel phones. The basic problem at the descriptive level is to determine if Eastern Andalusian laxing is truly systematic and to what degree. A variety of factors, such as sociolinguistic variation, can influence the quality and consistency of a phonetic sampling. This new phonetic survey is based on a sampling taken from a selected group of speakers who clearly manifest the phenomenon. These data provided the basis for my doctoral thesis, Sanders (1994).

2. Earlier investigations

Navarro Tomás (1939) was one of the first investigators to note the special characteristics of the alternation of open and closed vowels in Eastern Andalusian. His observations delineate the essen-

tial parameters of the processes and issues. According to Navarro Tomás, the weakening (aspiration) or deletion of syllable-final /s/ and /θ/ regularly opens the adjacent vowel (cf. Hualde & Sanders 1995 for a different interpretation). The vowel affected by the loss of the word-final consonant is not only more open, but it also appears to be lengthened. Words consisting of the same string of consonantal segments are distinguished by the quality of the vowels. As noted, speakers of Eastern Andalusian are able to make semantic distinctions according to the alternations in vowel quality. For example, it is possible to distinguish semantically between the singular and the plural according to the alternation in vowel quality of the final /a/ in the words *boca* [bóka] 'mouth' and *bocas* [bóka] 'mouths'.¹ The apparent semantic value of the vocalic alternation is not limited to the singular/plural distinction. The second and third person of several verb tenses are also distinguished by vowel quality, e.g. *vendrá* [bendrâ] 'he, she, it will come' and *vendrás* [bendrâ] 'you will come'. Navarro Tomás points out that this parallelism serves to differentiate related pairs such as *dio* [djó] 'he, she, it gave' and *dios* [djó] 'god'.

The aspiration and deletion of /s/ and /θ/ is related to a more general syllable-final weakening process involving /r/, /l/, /n/, and /d/. The deletion of consonants from this latter group also triggers an opening of the adjacent vowel. Navarro Tomás indicates that the vowels affected by the deletion of /r/ and /l/ are of a different quality from those affected by /s/. In the words *piel* [pjé] 'skin' and *pies* [pjé] 'feet' and *mies* [mjé] 'seeds' and *miel* [mjé] 'honey' the word-final vowel is open in both cases, but is lengthened only in the latter. Furthermore, the [e] in *pies* and *mies* is more open than in *piel* and *miel*.

Since the earlier work of Navarro Tomás several investigators have attempted to describe with greater precision the phonetic character of the Eastern Andalusian vowels. Rodríguez-Castellano & Palacio (1948) and Alonso et al. (1950) offer the most complete surveys.

Rodríguez-Castellano & Palacio (1948) discuss in detail their investigation on the dialect spoken in the town of Cádiz, Granada. Their findings reveal that the aspiration of word-final /s/ in the plural affects not only the adjacent vowel, but all the vowels in the word. This phenomenon is particularly noticeable in the mid-vowels, e.g. *lobos* [lóβɔ] 'wolves', *melones* [mɛlónɛ] 'melons' and *orejas* [oréha] 'ears'. Word-final /a/ in words like *orejas*, *tendrás* 'you will have' and *irás* 'you will go' are described as having a velar quality. The conclusion reached by Rodríguez-Castellano & Palacio is that the vowel

quality of the plurals is in distinctive opposition to that of the singular forms. The native speakers of Cabra, especially the younger generation in 1948, were able to distinguish singular from plural forms by vowel quality alone even in words without the slightest trace of the aspirated /s/.

They report that in syllable-final position the quality of the vowels adjacent to /r/, /l/ and /θ/ is also affected. These coronals become relaxed to the point of aspiration and/or deletion. The adjacent vowel assumes an open quality, but not to the same degree as occurs with word-final /s/. In addition, the lax quality of the final vowel does not spread to other vowels in the word. Words such as *perol* [peról] 'pot' and *aperador* [aperaól] 'provider' have an open vowel only in the final syllable. Rodríguez-Castellano & Palacio note that, whereas in a plural form such as *peróles* [peróle] all vowels are open, the opening of the final vowel caused by the deletion of the final /l/ in its singular *perol* [peról] does not affect other vowels. That is, even though the final vowel of a singular form may be open, vowel harmony occurs in plural but not in singular forms.

Rodríguez-Castellano & Palacio make a number of interesting observations on the phonetic description of the vowels. They characterize the acoustic effect of the open [a] in the plural as being slightly velar. This articulation, however, does not correspond, in their opinion, to the velar /a/ found in Galicia and Asturias. The velar /a/ of these regions is formed by a retraction of the tongue. In the dialect of Cabra the tongue is actually elevated from its normal position. The initial movement of the tongue seems to be in the direction of the articulation of a coronal /s/. Rodríguez-Castellano & Palacio note that this frontal movement is contradictory to the natural articulation of a velarized /a/. This description of the fronting of the plural [a] is confirmed by the subsequent investigations of Alonso et al. (1950) and Salvador (1957, 1977). Rodríguez-Castellano & Palacio attempt to reconcile the acoustic perception of velarization with the observed anterior articulation. They suggest that the perception of a velar quality originates in the resonance caused by the aspiration of /s/. In most instances the aspirated /s/ seems to have entirely disappeared. The last evidence of the aspiration is an increase in resonance or a somewhat 'throaty' timbre (*engolamiento*) in the articulation of /a/. A precise description of this realization of /a/ in Eastern Andalusian has been a source of continuing difficulty.

The Alonso et al. (1950) survey has become a standard data set for many later analyses. This survey provided the first systematic picture of the singular/plural alternation according to the categories

of the vowels affected. Examples from these data show the systematic mutation of the vowels in the plural forms, especially in word-final position. Word-final mid-vowels are consistently open even when the plural marker is not present even as an aspiration. Word-final /a/ is regularly realized as an open fronted [a]. Tonic mid-vowels are open in the plural in all the citations, including both closed and open syllables. The low vowel /a/ in tonic position is inconsistent. Plural tonic /a/ is realized as either a normal [a] or an open [a]. Tonic high vowels are inconsistent. The high front vowel /i/ is variable in the plural forms; *castillos* and *pisos* show open tonic vowels while *gallinas*, *molinos* and *pepitas* do not. Tonic /u/ in the plural is open in open syllables, but is closed in closed syllables.

(1) Alonso et al. (1950)

	SINGULAR	PLURAL	GLOSS
<i>asa</i>	ása	ásä	'handle'
<i>capa</i>	kápa	kápä	'cape'
<i>beso</i>	el βésa	lɔ ^h βésɔ	'the kiss'
<i>boca</i>	bóka	bókä ^h	'mouth'
<i>poco</i>	póko	pókɔ ^h	'little/few'
<i>castillo</i>	ka ^h tiyo	lɔ ^h ka ^h tiyo	'castle'
<i>gallina</i>	úna yayina	la yayinä ^h	'hen'
<i>molino</i>	molíno	molínɔ	'windmill'
<i>pepita</i>	pepíta	pepitä ^h	'seed, pip'
<i>piso</i>	píso	písɔ	'floor'
<i>mil</i>	míl	míle ^h	'thousand'
<i>nube</i>	núbe	lɔ ^h núβe	'cloud'
<i>pluma</i>	plúma	plumä	'feather'
<i>bulto</i>	búlto	búltɔ	'bulk'

One of the principal deficiencies of the Alonso et al. data is the paucity of trisyllabic citations, at least in terms of vowel combinations. A large portion of the data set consists of bisyllabic words. Based on these limited data it is difficult to ascertain the systematic distribution of open or closed vowels in the pretonic syllable of paroxytones. Alonso et al. indicate that the stable quality of /a/ makes it more resistant to mutation and that the mid-vowels /e/ and /o/ close in the singular and open in the plural in pretonic position. This is particularly true when the pretonic and the tonic vowel are the same, e.g. *corona* [koróna] 'crown' vs. [korónä] 'crowns'.

As mentioned above, these data have led the investigators to

suggest that a fundamental change has evolved in the vowel system of Eastern Andalusian. Navarro Tomás had proposed that Eastern Andalusian may have doubled the vowel inventory of standard Castilian from five to ten. The problematic behavior of the high vowels led Alonso et al. to reduce this inventory to seven: *o*, *ɔ*, *e*, *ɛ*, *ə*, *i*, *u*. Following the publication of the Alonso et al. data a clearer picture began to emerge regarding the systematic nature of the Eastern Andalusian vocalism. Investigators such as Alvar, Salvador, Alarcos Llorach, and Mondejar began to concentrate on the role of the vowel alternations in phonological organization.

The variety of Eastern Andalusian as spoken in Granada, as described by Alonso et al. (1950), appears to limit the tense/lax alternation to the mid and low vowels. However, this system of eight vowels can be subject to further modification. Alonso et al. indicate that in the plural there is a remarkable similarity between open [ɛ], sometimes transcribed with two openness diachritic subscripts, and the palatal open [ä], e.g. *las vides* [lãv viðəh] 'the vines' and *las vidas* [lãv viðəh] 'the lives'. Alonso (1956) made a study of the variety of Eastern Andalusian spoken on the frontier of the provinces of Córdoba and Granada. In this study he found that the [ɛ] and [ä] associated with syllable-final weakening have nearly merged to a very lax [ɛ]. This convergence has interesting phonetic and phonological implications. The forces that have produced the "doubling" of the vowel system have also led to a near neutralization of two vowel phonemes, /e/ and /a/, which are distinct in all other varieties of Spanish.

Alvar (1955) in his discussion of the data from *Atlas Lingüístico y Etnográfico de Andalucía* proposed that the phonology of Eastern Andalusian has undergone a major restructuring. He adheres to the concept of *desdoblamiento*; that the "doubling" of the vowel system from five to ten has created a phonology with five degrees of height. Alvar notes that this would make the Eastern Andalusian vowel system a very complex one. The system proposed by Alvar is shown below.

(2)	i	u
	j	y
	e	o
	ɛ	ɔ
	ä	ä

This system includes a distinctive open/closed opposition for the

high vowels. The Alvar position is important because it represents the logical, and complex, interpretation of the tense/lax alternation as a phonologization of this feature. Alvar points out the problematic nature of /a/ within this system. The oppositions involving the high and mid-vowels are of height. The low vowel /a/ appears to have a more complex set of phonetic oppositions. In the plural, /a/ may be realized as a palatal [ä] or an open [a]. The palatal [ä] or [ä] only occur in word-final position. The open [a] appears in other positions within the word. The distribution of the varieties of /a/ and their phonetic details require further clarification. This will be one of the principal objectives of the current study.

Salvador (1957, 1977) and Alarcos Llorach (1958, 1983) have engaged in an ongoing polemic on the structure of the Eastern Andalusian vowel system. Salvador has favored different versions of the *desdoblamiento* theory originally proposed by Navarro Tomás. Alarcos Llorach has developed the notion that the systematic mutation of vowels in the plural is due to a coarticulatory element 'x' associated with the aspiration or deletion of /s/. Alarcos Llorach has further developed this line of thought by proposing that [h] has become phonemic in Eastern Andalusian. The phenomena associated with the syllable-final weakening of /s/ are actually reflexes of the phoneme /h/.

Salvador discusses Eastern Andalusian vocalism in his dissertation "El habla de Cúllar-Baza" (1957) and again in articles in 1977 and 1985. In the 1957 dissertation he proposes a ten vowel system with five degrees of distinctive height. This is essentially the *desdoblamiento* theory. In the 1977 article the binary feature system of SPE phonology is adopted and the primary distinctive features are tense and lax. The earlier system was based on the dissertation research findings which showed a distinctive function for openness. Salvador indicates that word-final plural /a/ is realized as the open and fronted [ä]. The plural mid-vowels /e/ and /o/ are realized as the open [ɛ] and [ɔ]. In word-final position Salvador indicates a slight opening of the high vowel /i/ and /u/ to [j] and [ɥ].

(3)	ORTHOGRAPHY	SINGULAR	PLURAL	GLOSS
	<i>masa, masas</i>	<i>mása</i>	<i>másä</i>	'dough'
	<i>perro, perros</i>	<i>pérro</i>	<i>pérro</i>	'dog'
	<i>solo, solos</i>	<i>sólo</i>	<i>sólö</i>	'alone'
	<i>mi, mis</i>	<i>mí</i>	<i>mí</i>	'my'
	<i>su, sus</i>	<i>su</i>	<i>sü</i>	'his/her/their'

Based on these data, Salvador proposed a vowel system with six degrees of vowel height, as shown below.

- (4)
- | | | | | | | |
|---|---|---|---|---|---|---|
| i | j | e | ɛ | a | ɶ | u |
| | | | | | o | y |

Alarcos Llorach (1958) found the vowel systems proposed by Alvar (1956) and Salvador (1957) to be excessive. They had proposed vowel systems with five, or even six, distinctive vowel heights. Alarcos Llorach correctly points out that such a system is inherently unstable and subject to the progressive neutralization of such relatively minor differences. He was the first to suggest that the *desdoblamiento* of Eastern Andalusian involved a doubling of the system itself, rather than the entire inventory of phonemes. Alarcos Llorach attempts to account for the systematic processes associated with the apparent changes in the vowel system. The aspiration and deletion of /s/ leaves other traces besides changes in vowel height. One of the characteristics of the vowels affected by aspiration is greater length. Another is gemination when there is a following consonant. Alarcos Llorach points out that the vowel affected by /s/ aspiration is longer and more open only in absolute-final position; that is, before a pause. In other positions the result is not an increase in vowel length, but a gemination with the following consonant.

Alarcos Llorach suggests that there are three possibilities for a distinctive functional process: (1) the open/close vowel alternation is distinctive (2) the consonant modification is distinctive (3) both modifications, with the addition of vowel lengthening before a pause, are reflexes of the same functional process. Alarcos Llorach proposes the existence of a distinctive functional element. This element, simply designated as 'x', modifies by contact both the previous vowel and the following consonant. The element 'x' is also the conditioning factor for the metaphony process affecting the preceding vowels within the word. Alarcos Llorach claims that this interpretation dispenses with the necessity of adding five new vowels to the phonemic inventory.

Alarcos Llorach proposes that Eastern Andalusian has two vowel subsystems. One set of shorter vowels is pronounced with a narrowing of the vocal tract; a second set is longer and is pronounced

with a wider opening. This bisystemic organization is very similar to the distinct harmonic sets found in true vowel harmony. This system is shown in the following example from Alarcos Llorach.

- (5)
- | | | | | | | | | | |
|---|---|---|---|--------|---|---|---|------|---|
| u | o | i | e | a | U | O | E | A | I |
| | | | | narrow | | | | wide | |

Alarcos Llorach argues that consolidating these variations as the phonetic realizations of the phoneme /h/ represents a significant generalization. The alternative would be to postulate a separate phoneme characterized only by its regressive opening and lengthening of the preceding vowel and its progressive gemination with the following consonant.

The system proposed by Salvador (1977) consists of nine vowel phonemes distinguished by the binary features tense and lax. The mid and low vowels show a much greater difference in the degree of openness characterizing the singular and plural forms. The problematic nature of /u/ led Salvador to eliminate a height opposition for this vowel. He notes that word-final /u/ is extremely rare in Spanish and that the distinction between the tense and lax alternants could only be made by a minority of cultivated speakers. The phonemic status of the alternation of the high vowel /i/ is maintained because certain pairs can be distinguished by the tense/lax alternation, e.g. *perdi* [perdi] 'I lost' vs. *perdiz* [perdi] 'partridge'. Salvador makes the important point that the native speakers of a dialect determine what is acoustically distinctive. For example, the speakers from western Andalusia may pronounce *casas* 'houses' as [kása] but fail to recognize the lax form as being plural without the support of semantic context.

Salvador is not satisfied with the Alarcos Llorach (1958) explanation. He notes that vowel lengthening is not exclusive to the series of open vowels, and that vowel opening and consonant gemination would be redundant markers. If this is the case, then determining the pertinent feature will be difficult. Salvador prefers to modify his original proposals by considering Eastern Andalusian vocalism in a universal linguistic context. He notes the phonetic similarity of the fronted vowels, *vocales proyectadas*, to the feature ATR (advanced tongue root) found in a wide variety of world languages. Salvador describes the articulation of the entire series of open vowels as being

alternation of the mid-vowels /e/ and /o/ between singular and plural forms in tonic and word-final position. In pretonic, or word-initial, position, /i/ shows a slight alternation between singular and plural forms. Llisterri & Poch observe that pretonic and tonic /a/ show virtually no alternation, while final /a/ has a slightly palatal articulation in the plural. Based on these data, the palatalization of word-final /a/ in the plural must be characterized as a very minor tendency.

The results of the Martínez Melgar and the Llisterri & Poch studies shed some light on the nature of the vowel quality alternations observed in the earlier investigations. These findings also raise some doubts as to the degree and consistency of the alternations. In the Martínez Melgar data the only alternation of interest involves tonic /e/. Vowel length appears to play some role as suggested by Alarcos Llorach, since final vowels with the exception of /a/ are somewhat lengthened in the plural. Most striking is the absence of word-final palatal [ä]. The Llisterri & Poch survey offers a better prospect. The mid-vowels in tonic and word-final position show a regular, if small, alternation between the singular and the plural forms. Llisterri & Poch claim to have revealed a palatal [ä] in word-final position, but the degree of alternation is relatively minor.

4. Experimental design

Clearly, the nature of the phonetic realizations and the organizational structure of the Eastern Andalusian vowel system still have not been precisely described. If the results of the recent instrumental studies represent an authentic description of Eastern Andalusian vocalism, then the observations of investigators such as Navarro Tomás, Rodríguez Castellano & Palacio, and Alonso et al. remain uncorroborated in part. The Llisterri & Poch study shows a truly systematic vowel alternation in formant values between singular and plural forms for the mid vowels. But the distinctive plural palatal [ä] in word-final position that had been described by earlier investigators is present only as a very minor phonetic detail.

The objective of our study is to describe and explain the general pattern of vowel quality alternations obtaining in the singular and plural noun forms in a variety of regularly occurring contexts. The prepared questionnaire used in the study samples the vowel quality alternations in a wide variety of possible trisyllabic vowel combinations. For example, the trisyllabic combination *aaa* is realized in the word *patata* 'potato', and the combination *aoa* in *zapato* 'shoe', etc.

The results of this survey will indicate how each vowel phoneme is realized in a range of contexts.

The words or "tokens" used for the survey contain the majority of occurring trisyllabic combinations. The objective was to determine if particular concatenations of vowels resulted in differences in vowel quality. The systematic organization of the questionnaire according to trisyllabic vowel combinations should reveal any special behavior on the part of /a/ and the high vowels /i/ and /u/. One of the facts of the occurrence and distribution of vowels in Spanish is the small number of word-final high vowels. Words with final high vowels play a limited role in the general distribution patterns of the language; it is impossible to find a sufficient range of trisyllabic vowel combinations, particularly when the open syllable criterion is added. For this reason it was decided not to include word-final high vowels in this survey. High vowels are, of course, included in tonic and pretonic positions. Therefore, all of the possible trisyllabic vowel combinations, excluding word-final high vowels are included in this survey, e.g. *aaa*, *aae*, *aoa*, *eea*, *eee*, *eeo*, etc.

The questionnaire used for this survey consists of "carrier" phrases into which 80 selected trisyllabic "tokens" are inserted. For example, the word *patata* is inserted into the carrier phrase *Digo... por ti* 'I say (the word) for you' with the singular/plural selection indicated by the definite article.

- (7) patata la Digo la patata por ti.

The primary data used in this study was collected in a survey carried out during the summer of 1992. The informants for the survey were all male university students between the ages of 20 and 24 from the University of Granada. All the informants were from the *Facultad de Ciencias* (College of Science) and did not have an explicit knowledge of the linguistic details associated with their own dialect. They were aware, however, of the sociolinguistic implications associated with *andalucismos* and the role of language in popular culture. No attempt was made to disguise the linguistic nature of the survey.

The three subjects are from villages near the city of Granada: Ogijares, Dílar, and Cúllar Vega. The informants, their parents and their grandparents are all native to the province of Granada. In all cases neither the parents nor the grandparents of the informants are university graduates. This selection is intended to ensure a sampling that reflects an authentic regional speech pattern. Using these criteria it should be possible to avoid the influence of the standard dialect

and hypercorrection. The informants of the Alonso et al. survey also were all associated with the University of Granada. The selection of the informants for the new survey was expected to reflect a speech pattern somewhere between cultivated *granadino* and the local village dialect. The objective of the survey is not necessarily to prove that the vocalic alternations in question are present systematically in all, or even a majority, of the inhabitants of Eastern Andalusia. This would be beyond the scope of the current study. The purpose is to take a sampling from a more limited group in which the vocalic alternations are likely to be a regular feature.

The sampling taken in these recordings was computer digitized using a Macintosh IIsi computer with the Sound Edit program. The phonetic scoring of the vowels was done using the Signalize 2.01 sound analysis program. The vowels of each trisyllabic word were analyzed for the first (F1) and second (F2) formant frequencies in Hertz (*hz*) and duration in milliseconds (*ms*).

This procedure yielded scoring for three informants pronouncing 160 carrier phrases, each phrase containing a target token. Each token contains three vowels: (3) informants x (160) tokens x (3) vowels = 1440 vowels scored. The general averages for all informants can be found in Table I:

Table 1: average values

	singular			plural		
Pretonic <i>a</i>	640.01	1466.53	60.28	683.57	1447.56	58.24
Tonic <i>a</i>	658.02	1484.30	86.98	689.02	1491.63	90.18
Word-final <i>a</i>	620.73	1393.09	76.85	649.13	1532.92	73.50
Pretonic <i>e</i>	479.75	1830.53	62.02	588.66	1664.94	57.47
Tonic <i>e</i>	476.07	1937.76	84.78	579.26	1791.52	85.47
Word-final <i>e</i>	489.15	1867.41	70.33	568.06	1774.16	69.44
Pretonic <i>o</i>	482.44	1077.49	64.08	578.97	1113.49	61.10
Tonic <i>o</i>	504.96	1119.66	85.92	602.31	1179.86	86.99
Word-final <i>o</i>	497.03	1099.99	75.43	564.49	1147.82	74.97
Pretonic <i>i</i>	352.68	2233.98	63.16	354.06	2216.65	57.67
Tonic <i>i</i>	330.06	2256.74	77.65	342.97	2213.15	71.85
Pretonic <i>u</i>	361.04	924.15	63.73	364.08	926.95	59.82
Tonic <i>u</i>	369.57	974.50	83.71	369.35	978.08	83.84

A more detailed presentation of the results according to the specific vocalic context is given in Table II, in the appendix at the end of this article. The results are discussed in the following section.

5. Discussion of the results

Generally, the results of our experiment show a notable and consistent alternation in vowel quality between the singular and the plural forms. The degree of these alternations is greater and the distribution more widespread than in either the Martínez Melgar or the Llisterra & Poch studies. These alternations involve the mid vowels in all positions and contexts. The distinctive palatal [ä] in word-final position is much more clearly identified than in the previous studies. The degree of alternation and the localization of word-final plural [ä] strongly confirm the observations of original investigators such as Rodríguez-Castellano & Palacio and Alonso et al. The precise nature of the phonetic realizations of pretonic and tonic /a/ is clarified. In the following subsections the obtained values in pretonic, tonic and post-tonic position are examined. The data were subjected to an analysis of variance (ANOVA) whose results are also discussed.

5.1. Pretonic vowels

The general averages for pretonic vowels reveal an alternation in vowel quality for the mid vowels, which are considerably more open in the plural. There is also an alternation for the low vowel /a/. Plural /a/ is more open and slightly back. The high vowels show no apparent alternation in pretonic position. An ANOVA test was performed. For pretonic /a/ the singular/plural alternation is statistically significant for F1, but not for F2. This confirms that pretonic plural /a/ is lower but not fronted. For pretonic /e/ the ANOVA reveals that the singular/plural alternation for this vowel is statistically significant for both F1 and F2. This confirms that pretonic plural /e/ is more open and centralized. For pretonic /o/ the ANOVA reveals that the singular/plural alternation is statistically significant for F1, but not for F2. Pretonic plural /o/ is lower, but not significantly centralized. As noted, pretonic /i/ and /u/ do not show substantial alternations in formant quality. The difference in duration; the plural high vowels being shorter than their singular counterparts. Short vowels may indicate participation in the phonological pattern of tense/lax alternations even without a change in formant quality.

5.2. Tonic vowels

The pattern is similar to pretonic position, except that the alternation for /a/ is apparently not as large. The alternation of the mid-vowels is considerable, but the high vowels show no alternation in quality. Length is not a consistent feature for the tonic vowels. In the plural, tonic /a/, /e/, and /o/ are longer; tonic /u/ is even, and tonic /i/ is shorter.

An examination of Table II reveals some interesting variations for tonic /a/. Before word-final /e/ and /o/ the pattern resembles that found in pretonic position. In these contexts plural tonic /a/ is lower and more back in its localization. Plural tonic /a/ before word-final /a/ is notably different; it shows the distinctive palatalization associated with plural word-final [a]. This difference in the behavior of tonic /a/ was not identified in any of the previous investigations. Table II shows that plural tonic /a/ participates in vowel laxing with two distinct realizations. Plural word-final [a] projects its palatal quality to tonic /a/ only. Plural tonic /e/ and /o/ before word-final palatal [a] are very open, but show no evidence of extreme fronting. The ANOVA revealed that the singular/plural alternation for tonic /a/ is statistically significant for F1, but not for F2. This is similar to the pattern which obtains for pretonic /a/, indicating that lowering is the important factor in these positions.

Tonic /e/ in the plural has a very open articulation. Tonic /e/ shows little variation for duration between the singular and the plural, with the plurals being slightly longer. The ANOVA revealed that the singular/plural alternation is statistically significant for both F1 and F2. This is the same pattern which obtains for pretonic /e/. Tonic /o/ in the plural also has a very open articulation. Plural tonic /o/ is somewhat longer before word-final /a/, and somewhat less so before word-final /o/ and /e/. Length does not appear to be an important feature in tonic position. The ANOVA revealed that the singular/plural alternation for tonic /o/ is statistically significant for both F1 and F2. Centralization is therefore statistically significant in tonic position.

Tonic /i/ shows a slight alternation in vowel quality. In the plural F1 is slightly higher and F2 is lower by 43.59 Hz, indicating a minor laxing effect. Tonic /i/, on the other hand, shows a very large difference in vowel length between the singular and the plural. The general average for duration indicates that plural tonic /i/ is nearly 7 ms shorter than its singular counterpart.

5.3. Word-final vowels

The mid-vowels continue their normal pattern of singular/plural

alternation, with the plural vowels being very open or lax. Word-final /a/ is open and palatalized. The high vowels were not included in the sampling. The most interesting alternation involves word-final /a/. The distinctive plural palatal [a] is very apparent. For plural /a/ F1 is 29.6 Hz lower and 139.83 Hz higher, indicating a slightly lower, very palatal articulation. This palatal realization is much greater than that indicated in the Llisterri & Poch study, in which F1 was only 8.7 Hz lower and F2 60.8 Hz higher. The word-final plural /a/ revealed here is precisely the articulation claimed by Alonso et al. (1950), Salvador (1957, 1977), and others. The distribution pattern for word-final and tonic /a/ clarifies a number of claims that have been made regarding these phenomena. The ANOVA revealed that the singular/plural alternation for word-final /a/ is statistically significant for F2, but not for F1. This is a direct confirmation of the palatal character of /a/ in the plural. Although the alternation for F1 is not statistically significant, the actual difference (26.617 Hz) and the critical difference (27.556 Hz) are close enough to indicate that lowering must be taken into account.

Word-final /e/, as indicated, has a very open articulation. There is very little difference in length between the singular and the plural. The singular vowel is somewhat longer, but not enough to indicate a distinctive difference. The ANOVA revealed that the singular/plural alternation for word-final /e/ is statistically significant for both F1 and F2. This makes /e/ the only vowel to show a statistically significant alternation for F1 and F2 in pretonic, tonic, and word-final positions. Word-final /o/ is very open, but not to the same degree as word-final /e/. The singular vowel is also somewhat longer, although the difference is not substantial. The ANOVA reveals that the singular/plural alternation for word-final /o/ is statistically significant for both F1 and F2. Although the alternation for F2 is statistically significant, the actual difference (47.833 Hz) and the critical difference (47.433 Hz) are close enough to indicate that centralization is minimal.

6. Vowels in free conversation

It may be objected that the artificiality of the experimental conditions led the speakers to exaggerate the difference between singular and plural vowels. From the results of our experiment we can conclude that speakers are able to use vowel quality to differentiate between singular and plural forms. But how consistently are these contrasts made in natural speech? To begin to answer this question, we analyzed several singular/plural minimal pairs extracted from a recorded free conversation with one of our subjects. The results are given in (8):

(8) Comparison of minimal pairs from free conversation

	DUR.	F1	F2	DUR.	F1	F2
cosa				cosas (avg. of two examples)		
'o'	76.6	519.7	1019.0	'o'	57.1	550.3
'a'	76.2	586.0	1615.2	'a'	59.6	639.5
mote (avg. of two examples)				notes		
'o'	110.3	647.1	996.2	'o'	60.1	698.0
'e'	74.8	519.7	1872.5	'e'	42.6	580.9
taco				tacos (avg. of three examples)		
'a'	113.9	652.2	1503.1	'a'	81.8	725.2
'o'	48.9	524.8	1044.5	'o'	75.3	586.0
todo (avg. of three examples)				todos (avg. of two examples)		
'o'	80.8	546.9	1194.0	'o'	85.6	578.4
'o'	66.7	550.3	1083.6	'o'	68.1	603.8

In the alternation between the singular and plural forms of *mote* the F1 of the plural is +51 Hz higher than its singular counterpart. The F2 is +181 Hz higher, indicating a much more centralized variant. The tonic [o] of *cosa* is also more open and centralized in the plural. In *todo* the alternation is very small in tonic position, while it is somewhat greater in word-final position. The greatest degree of difference for F1 in [o] occurs in word-final position in *taco* 'expletive' in which the plural is +61 Hz higher. The degree of difference for tonic [o] does not approach that found in the experiment, e.g. for plural tonic [o] F1=+97 Hz and F2=+60 Hz. The degree of difference for word-final [o] in *tacos* is more comparable to the findings of the experiment, e.g. for word-final plural [o] in *tacos* F1=+61.2 Hz and F2=+25.5 Hz versus F1=+68 Hz and F2=+50 Hz for the scoring averages. The only example for /e/ indicates a substantial alternation between the singular and plural forms. Word-final plural [e] in *notes* shows an F1 +61.2 Hz higher and an F2 -231.8 Hz lower, indicating a more open, central articulation. The scoring averages for all informants indicate an F1 +79 Hz higher and F2 -93 Hz lower. The two examples involving /a/ indicate only a slight tendency to a more open articulation in the plural.

These examples serve only to indicate that a systematic alternation of tense/lax vowels may obtain in free conversation. The alternation may be redundant as indicated by López Morales (1984), or simply one of several possible alternative plural markers as suggested by

Villena Ponsoda (1987). A resolution of this issue awaits a comprehensive survey of naturally occurring forms in free conversation. An additional acoustical survey is needed to determine the degree of alternation native speaker may find to be distinctive, or potentially distinctive, in a given context.

7. Conclusion

Vowel laxing can be manifested by various implementations. Ladefoged (1982:206-05) discusses the difficulties of describing the differences between tense/lax pairs of vowels. In an African language like Twi (spoken in Ghana) there are sets of wide and narrow vowels. In wide vowels the root of the tongue is drawn forward, the larynx is lowered, and the pharynx is enlarged. Narrow vowels do not have these features. Not all Twi speakers implement the wide/narrow alternation with the same oral articulations; the relative size of the pharyngeal cavity is the only constant. Tense and lax vowels have been described as being wide and narrow, respectively. Ladefoged indicates that width is a measurable phonetic quality, while tense/lax is more useful for specifying phonological alternations. The point is that the determination of tense/lax pairs may involve more than one articulatory or physiological action. There is no absolute criteria for a standard of consistent phonetic reality in the implementation of the tense/lax alternation. Certainly a co-occurrence of alternations involving height and duration are expected, but not guaranteed. Other features such as centralization or relative tongue position may become relatively more important in the phonetic realization.

The scoring averages obtained in our study can be compared with data taken for other languages having a phonemic opposition of tense/lax mid vowels. Martínez Celdrán, using data taken from Cerdá (1972:166) has constructed a graph for the eight vowels of Catalan. These data are incorporated into the following table, which also includes data from Italian and Yoruba (Disner 1983) and the scoring averages for our eastern Andalusian informants in tonic and word-final position. In this table the frequency in Hertz is given for the first (F1) and second (F2) formants with the difference directly below in italics. These indicate that the tense/lax alternations which obtain in eastern Andalusian in certain contexts are comparable to some languages in which this opposition is phonemic. The F1 for Eastern Andalusian mid vowels is higher for both open and closed variants. In Eastern Andalusian F1 for open tonic [e] is +103 Hz higher than closed tonic [e], while F2 is -146 Hz lower. This is most

comparable to Catalan, where the figures are +90 Hz and -150 Hz, respectively. On the other hand, in Eastern Andalusian the difference between [e] = [ɛ] and [e] in word-final position is much less than that which obtains in any of the other languages represented in the table. Yoruba shows the greatest degree of differentiation between [ɛ] and [e].

In Eastern Andalusian the degree of alternation for [ɔ] = [ɔ̄] and [o] is smaller than in any of the other languages cited in the table. The alternation for F1 is comparable to the cardinal vowels and Catalan, but the difference for F2 is only +60 Hz in the tonic position and +50 Hz in word-final position. In word-final position the low vowels of Eastern Andalusian resemble the cardinal vowels.

Word-final plural [a] in Eastern Andalusian is open and fronted. The cardinal vowel /æ/ is represented as being fronted by +350 Hz for F2 with respect to cardinal /a/. In Eastern Andalusian word-final plural [a] F2 is +137 Hz higher than its singular counterpart.

These data point out the positional nature of eastern Andalusian vowel laxing. Mid vowels in tonic position are more susceptible to laxing; and in some contexts the vowel alternants verge on the degree of difference found in languages, such as Catalan, where the tense/lax opposition is phonemic.

(9) Cross-linguistic comparison of tense/lax vowels

	CARDINAL		CATALAN		ITALIAN		YORUBA		E. ANDALUSIAN	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
e	350	2400	330	1800	400	2000	375	2100	sg. 476	1938
e	470	2100	410	1650	530	1890	575	1900	pl. 579	1792
	+120	-300	+90	-150	+130	-110	+200	-200	+103	-146
o	350	850	300	700	425	775	410	1000	sg. 505	1120
o	460	950	400	875	560	890	590	1040	pl. 602	1180
	+110	+100	+100	+175	+135	+115	+180	-40	+97	+60
a	700	1300	530	1150	775	1225	800	1440	sg. 658	1484
									pl. 689	1491
									+31	+7
æ	700	1650							pl.	649
	+0	+350								+28

The primary goals of this work have been to identify the vowel inventory of Eastern Andalusian Spanish and to clarify the processes responsible for the distribution of the vocalic alternations which obtain. The results of our study corroborate the observations of earlier investigators such as Alonso et al. (1950) and Salvador (1957). According to our data, vowel laxing primarily affects the mid and low vowels. The laxing of high vowels is less consistent and is not statistically significant.

The issue of the functional role of vowel laxing remains unresolved. The degree of the vowel alternations appears to be sufficient to support a distinctive contrast. There is, however, limited evidence that native speakers make a consistent use of vowel laxing to make distinctive contrasts in normal speech. López Morales (1984) indicates that vowel laxing is almost always a redundant marker of plurality. This is supported by Villena Ponsoda's (1987) variationist model for plurality. Nevertheless, we must recognize the reality of Salvador's (1977) observation that in certain limited contexts native speakers use the alternations in vowel quality to make semantic distinctions without any other indicator of plurality. The results of our study support, at least in part, a modified version of the *desdoblamiento* interpretation of the Eastern Andalusian vowel phenomenon.

Martínez Melgar (1994) has published a more recent study which summarizes the results of her doctoral dissertation. This new study strongly confirms the findings of Sanders (1994), as summarized in this paper. The general averages for Martínez Melgar (1994) are compared with those obtained in Sanders (1994) in the following tables:

Table III

	singular		plural	
	F1	F2	F1	F2
Martínez Melgar (1994)				
[a]	647.66	1488.41	654.37	1441.30
[e]	494.12	1827.53	565.23	1656.83
[i]	389.44	2166.22	410.67	2073.11
[o]	490.79	1193.66	555.51	1250.50
[u]	396.49	1047.28	423.76	1116.56

Sanders (1994)

	singular		plural	
	F1	F2	F1	F2
[a]	648.59	1447.97	673.90	1490.70
[e]	484.66	1878.57	578.66	1743.54
[i]	341.37	2245.36	348.52	2214.90
[o]	494.81	1099.04	581.92	1147.05
[u]	365.30	949.50	366.72	952.15

These tables demonstrate similar findings for the mid vowels [e] and [o], which appear to have a notable alternation for aperture between the singular and the plural. Martínez Melgar indicates a very slight alternation for the high vowels [i] and [u]. The results of the instrumental two studies appear to confirm that a significant alternation for vowel aperture between singular and plural forms is a regular feature for the mid vowels in Eastern Andalusian.

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Appendix

Table II

PRETONIC 'a'	SING:	Gen. avg.	DUR.	F0	F1	F2
	a/á	60.28	65.76	130.40	640.01	1466.53
	a/é	54.93	58.51	128.90	682.19	1413.65
	a/ó	56.37	63.61	133.75	628.99	1554.06
	a/í	56.37	63.61	128.98	655.60	1327.01
	a/ú	58.24	57.72	130.95	627.29	1644.05
	a/ü	58.24	57.72	129.83	619.59	1422.93
PLURAL:	Gen. avg.	58.24	57.72	127.91	683.57	1447.56
	a/á	62.77	62.77	128.28	682.76	1392.13
	a/é	58.27	58.27	127.33	670.86	1514.98
	a/ó	50.33	50.33	126.31	698.60	1362.12
	a/í	60.59	60.59	130.04	666.35	1625.93
	a/ú	60.59	60.59	127.73	692.99	1384.62

PRETONIC 'e'	SING:	Gen. avg.	F0	F1	F2
	e/á	62.02	130.37	479.75	1830.53
	e/é	62.86	135.22	499.36	1922.79
	e/ó	59.84	128.24	491.51	1865.20
	e/í	61.63	130.04	451.78	1842.21
	e/ü	61.81	130.16	479.52	1825.80
	e/ü	65.40	129.60	468.74	1673.50
PLURAL:	Gen. avg.	57.47	127.90	588.66	1664.94
	e/á	59.30	131.65	608.02	1715.98
	e/é	58.78	127.70	603.95	1663.76
	e/ó	50.29	125.30	588.79	1661.05
	e/í	55.02	126.77	582.57	1655.40
	e/ü	63.08	128.18	549.73	1629.34

PRETONIC 'o'	SING:	Gen. avg.	F0	F1	F2
	o/á	64.08	129.21	482.44	1077.49
	o/é	61.08	127.39	506.12	1049.61
	o/ó	60.94	128.90	499.91	1179.82
	o/í	82.31	128.93	467.06	1029.66
	o/ü	62.51	129.72	457.42	1081.90
	o/ü	48.48	131.80	478.94	1071.69
	o/ü	61.10	126.78	578.97	1113.49
PLURAL:	Gen. avg.	62.84	125.89	563.88	1081.47
	o/á	56.28	127.98	610.88	1174.16
	o/é	71.91	126.53	579.59	1068.88
	o/ó	54.56	126.66	572.93	1123.78
	o/í	55.73	127.26	572.38	1144.74
	o/ü				

PRETONIC 'i'	SING:	Gen. avg.	F0	F1	F2
	i/á	63.16	130.17	352.68	2233.98
	i/é	64.31	129.41	362.32	2164.91
	i/ó	55.03	129.57	341.37	2294.55
	i/í	69.37	132.35	356.09	2124.15
	i/ü	57.46	131.12	355.52	2385.12
	i/ü	69.66	128.39	348.10	2201.15
PLURAL:	Gen. avg.	57.67	128.72	354.06	2216.65
	i/á	59.05	125.77	357.80	2184.73
	i/é	50.42	131.84	336.27	2277.57
	i/ó	64.19	131.94	352.13	2192.65
	i/í	50.47	127.30	369.68	2256.05
	i/ü	64.22	126.76	354.40	2172.28

PRETONIC 'u'	SING:	Gen. avg.	63.73	131.88	361.04	924.15
		u/a	74.87	130.40	357.80	967.18
		u/e	55.11	134.46	367.43	935.82
	PLURAL:	u/o	67.52	130.89	364.02	815.78
		u/i	58.79	130.08	347.62	840.96
		u/ú	61.72	134.43	371.97	1129.43
		Gen. avg.	59.82	130.08	364.08	926.95
	PLURAL:	u/a	67.71	128.73	356.11	969.15
		u/e	52.03	128.57	378.18	963.00
		u/o	65.55	132.33	374.79	849.22
		u/i	52.13	132.12	355.54	831.65
		u/ú	62.60	127.92	351.60	1069.12
TONIC 'a'	SING:	Gen. avg.	86.98	145.02	658.02	1484.30
		a/a	82.95	143.47	668.48	1526.88
		a/e	90.85	145.66	652.53	1489.84
	PLURAL:	a/o	87.76	145.62	653.88	1496.97
		Gen. avg.	90.18	143.29	689.02	1491.63
		a/a	91.54	144.00	696.01	1567.98
		a/e	89.71	141.75	697.03	1471.16
		a/o	92.77	143.44	670.19	1456.89
	SING:	Gen. avg.	84.78	146.35	476.07	1937.76
		e/a	80.61	146.04	478.68	1939.41
		e/e	84.10	146.96	463.97	1973.83
TONIC 'e'	PLURAL:	e/o	90.59	145.99	487.45	1892.49
		Gen. avg.	85.47	144.60	579.26	1791.52
		e/a	82.67	143.91	578.31	1806.53
		e/e	85.69	144.14	589.07	1783.89
	SING:	e/o	88.29	145.53	591.39	1750.39
		Gen. avg.	85.92	147.45	504.96	1119.66
		o/a	84.41	146.41	501.71	1094.13
	PLURAL:	o/e	86.77	147.63	510.21	1143.38
		o/o	85.89	148.68	512.92	1151.61
		Gen. avg.	86.99	144.55	602.31	1179.86
TONIC 'o'	SING:	o/a	83.98	144.11	616.87	1175.29
		o/e	87.02	144.12	598.53	1164.77
		o/o	88.04	145.28	593.44	1222.85
	PLURAL:	Gen. avg.	85.92	147.45	504.96	1119.66
		o/a	84.41	146.41	501.71	1094.13
		o/e	86.77	147.63	510.21	1143.38
		o/o	85.89	148.68	512.92	1151.61
	SING:	Gen. avg.	86.99	144.55	602.31	1179.86
		o/a	83.98	144.11	616.87	1175.29
		o/e	87.02	144.12	598.53	1164.77
	PLURAL:	o/o	88.04	145.28	593.44	1222.85

Notes

* The transcription of the vowels follows the system used by Alonso et al. and most other investigators in the Spanish linguistic tradition. In this system, openness is indicated by a comma subscript: [e], [o], [a]. A dieresis indicates fronting in [ä]. The interested reader, perhaps desiring to consult these original articles, will find this approach more convenient than a conversion to the IPA system.

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