New insights into Portuguese central-southern dialects: understanding their present and past forms through acoustic data from stressed vowels

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Abstract

This paper presents new acoustic data on Portuguese central-southern dialects, namely on the stressed vowels of the area. The data show important cues for the history of those dialects, as it can be seen that they are much more similar to one another than is traditionally assumed. Acoustic data on Portuguese central-southern dialects are proven to be of significance, hence, acoustic data on Portuguese dialects are increasingly needed in order to allow for better dialectological characterizations of Portuguese since those characterizations have been based only on auditory data until now.

> *When Daniel Jones, the greatest phonetician of the first half of the twentieth century, was setting out on a fieldwork trip, a reporter asked him, 'Professor Jones, what instruments are you taking with you?' He pointed to his ears and said, 'Only these.' There is no doubt that the ultimate authority in all phonetic questions is the human ear. But nowadays instrumental aids can often illuminate particular points, acting like a magnifying glass when we need to distinguish between two similar sounds*. (Ladefoged, 2003:27)

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1. Introduction[1]

As dialectological and historical studies put it, there are three main topics pertaining to the identity of Portuguese central-southern (CS) dialects: *a*) they take their origin from the north of the country and developed in a part of the former medieval Islamic empire; *b*) they are fairly homogeneous, containing two very distinct varieties / subdialects; *c*) they form the basis of standard Portuguese.

The Portuguese language has its origins in the northwest corner of the Iberian Peninsula in an area roughly matching the present-day Spanish province of Galicia and northwestern Portugal (see Teyssier, 2001; Castro, 2006). Portugal itself was born in the area of present-day northwestern Portugal as the *Condado* (county) *Portucalense* (Portuguese).

Spoken Latin evolved into Galician-Portuguese in the northwestern Iberian Peninsula throughout the early Middle Ages. During the Christian Reconquista it was transported to the remaining parts of present-day Portugal, and took the place of Mozarabic, Arabic and other foreign languages that were spoken there as a result of the Islamic invasion (Arabic being the dominant language in the area; cf. Neto, 1979:337; Menéndez Pidal, 1980:434; Teyssier, 2001; Castro, 2006). Following the independence of Portugal (XIIth cent.), the formerly uniform Galician-Portuguese language split into Portuguese and Galician (Maia, 1997; Teyssier, 2001; Castro, 2006).

Portuguese central-southern dialects evolved through a process that can be interpreted as a *koiné*, i.e. through a homogenization of the dialectal varieties that were brought from the north by Christian Portuguese settlers. As Castro (2006:151) puts it, from the end of the XIVth century on, as the country and its language become centered in the Coimbra-Lisbon-Évora axis, "An ancient conflict was resolved. As a consequence of the strategies undertaken during the Reconquista and its repopulating movement, north and south opposed; a reconquered, colonized, and sparsely populated Mozarabic center-south demarked itself from a stable and densely populated, Romanic, anciently settled north-northwest. The conquerors' language, carrying typical northern forms, imposed itself south of the Tagus River. But the colonization of a region with a less mountainous geography than in the north enabled easy communication, creating a close connection between populations that had different origins and dialects. This connection produced a dialectal leveling, which can be related to a process of *koiné*" (free translation).[2] It was this

[1] For purposes of phonetic transcription, the IPA chart as revised to 2005 was used. The phrase "standard deviation" is abbreviated to "sd".

[2] A good example of the enhanced uniformity of CS dialects is the fact that the isophones of the main pandialectal features of European Portuguese are placed

new-born Portuguese-speaking area that shaped standard Portuguese from the XIVth century on. Presently, one can in fact say that the standard variety of European Portuguese (EP) undergoes little influence from any area other than Lisbon (Brissos, 2012:12).

Despite the relative homogeneity of CS Portuguese, which does no more than maximize the general EP uniformity,[3] it includes two very idiosyncratic dialectal varieties.[4] In what regards central-southern Portuguese, those varieties are placed in opposite areas, as one is located in the central interior part of the country and the other in the southwest end; see Map 1 (Appendix, section I).

The idiosyncrasies of those two varieties pertain to their vowel systems, chiefly to stressed vowels (see Cintra, 1983b; Cunha & Cintra, 1984 (chap. 2); Segura & Saramago, 2001; Brissos, 2012:17-26). According to Segura & Saramago (2001:226-227) their main features can be summed up as follows:[5]

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mostly in the northern part of the country – not the south. See Cintra (1983b:160--161, Map 2).

[3] Portuguese speakers say that "a fishermen from the Algarve (in the south end part of the country) can easily have a conversation with a shepherd from Minho (in the north end)".

[4] For purposes of the dialectal classification of Portuguese, I follow Cintra's (1983b) proposal (which was first published in 1971: see References). Cintra establishes the existence of two main dialectal groups in European Portuguese: the "dialectos portugueses setentrionais" (*Portuguese northern dialects*) and the "dialectos portugueses centro-meridionais" (*Portuguese central-southern dialects*). Apart from the main groups (which in turn are subdivided into two different parts each), Cintra identifies three well-distinguished subdialectal areas (what he calls a "região subdialectal de características peculiares bem diferenciadas", i.e. literally *a subdialectal area with well-differentiated particular characteristics*). They are situated in areas that are distant from each other. One is set in the central interior part of the country and two are in opposite areas: one in the northwest part of the country and the other in the southwest part; see Map 1 (Appendix section I).

[5] In lack of additional information, all features pertain to the stressed vocalic system. Segura & Saramago (2001) give the most recent account of such features, but the inventories are fairly coincident among the post-Cintra (1983b/1971) literature (see e.g. Brissos, 2012:18-20 for the depiction of the variety located in central interior Portugal). Where the classification of Portuguese dialects is concerned, Cintra has been revised in only a few details. Previous to Cintra, the (very few) dialectological classifications of Portuguese depended mostly on geographical and administrative criteria. See the inventory of those proposals and several decisive remarks in Cintra (1983b:122-139); see also Brissos (2012:15, n. 13) for a few complementary remarks.

1. Subdialectal variety located in the central interior part of the country (CI)

   1.1. (Historical and standard Portuguese [6]) [u] undergoes a palatalization and is pronounced as [y]; e.g., [l'ymɨ] 'lume' ("fire"), [t'yd] 'tudo' ("all," "everything").

   1.2. [a] undergoes a palatalization and is pronounced [ɛ] when: *a*) there is or was one of the following sounds in the previous syllable: [i,j,u,w] (Portuguese high vowels and their semivocalic counterparts); *b*) a palatal consonant precedes the vowel; e.g., [piz'ɛðɨ] 'pisado' ("stepped"), [tɨʃkj'ɛɾ] 'tosquiar' ("to shear").

   1.3. The [o] that resulted from the monophthongization of ancient [ow] undergoes a palatalization and is pronounced as [ø]; e.g, [r'øpɐ] 'roupa' ("clothing" (n.)), [s'ø] or [s'øw] 'sou' ("I am").

   1.4. [e] is rounded and becomes pronounced as [œ]; e.g, [kuz'œɾ] 'cozer' ("to bake," "to cook"), [s'œʃt] 'cesto' ("basket").

   1.5. Final unstressed [u] disappears or is reduced to [ɨ]; e.g. (already mentioned), [s'œʃt] 'cesto' ("basket"), [piz'ɛðɨ] 'pisado' ("stepped").

2. Subdialectal variety located in the southwest part of the country (SW)

   The vowel system undergoes a chain reaction:

   2.1. Lowering of front vowels: [i] is pronounced almost as [e] in certain contexts (nasal consonants and [ɾ,r]), [e] is pronounced as [ɛ], and [ɛ]

[6] The present-day standard Portuguese stressed vowel system is as follows: /i, e, ɛ, a, ɔ, o, u/ and, to some, also /ɐ/; see full descriptions of the standard Portuguese vowel system and extensive references in Cunha & Cintra (1984, chap. 3), Mateus & Andrade (2000), Mateus & Brito & Duarte & Faria & Frota & Matos & Oliveira & Vigário & Villalva (2003, chap. 25). If one does not acknowledge the existence of the phoneme /ɐ/, the inventory of present-day standard Portuguese stressed vowel system is the same as that of Ancient Portuguese, which in turn was the same as the one of Spoken Latin from which it evolved (the common, spoken variety of Latin of the western Roman Empire; see for the most Castro, 2006, spec. 145-147). Thus the inventory of Portuguese stressed, phonological vowels – unlike their phonetic contextualization, which is a different matter – has been essentially the same since its origin. I will not approach the vowel [ɐ] (or /ɐ/) in this study, because: (i) as was seen, it is not settled that it is a real phonemic vowel, mostly because it would get its existence from a less productive phonetic opposition that occurs only in inflected forms of the same verb (e.g., 'cant**amos**' = [ɐ] = "we sing" *vs.* 'cant**ámos**' = [a] = "we sang;" 'jog**amos**' = [ɐ] = "we play" *vs.* 'jog**ámos**' = [a] = "we played;" 'trabalh**amos**' = [ɐ] = "we work" *vs.* 'trabalh**ámos**' = [a] = "we worked"); and, above all, (ii) it has no parallel in a great number of Portuguese dialects (Vasconcelos, 1970:112), CS included. That vowel has more than one pronunciation through the dialects, but the most frequent behavior is that both verb endings – *-amos* and *-ámos* – have the same pronunciation in each dialect (typically [ɐ], [ɐ̃], [e] or [ẽ], but also [a] or [ã] in the northwest).

is pronounced as [æ]; e.g., [ʃp'i̯ɾ] 'esp**i**rro' ("sneeze"), [s'ɛðɐ] 's**e**da' ("silk"), ['æɾvɐ] '**e**rva' ("grass").

2.2. [a] is pronounced as a back vowel, almost as [ɔ]; e.g., [m'ɒɾ] 'mar' ("sea").

2.3. [ɔ] is pronounced close to [o]; e.g., [av'ɔ̰] 'avó' ("grandmother").

2.4. [u] is palatalized and pronounced [y]; e.g., [t'yð] 'tudo' ("all," "everything").

This is a basic overview of the dialectal varieties at hand. For full descriptions see; for CI, namely its northern half (the district of Castelo Branco), Brissos (2012, chap. I) (the southern half of CI has not yet been the subject of a detailed and full description); for SW, Hammarström (1953), Maia (1975), Segura (1987).

As one goes into detail and examines the inventories of the features that are understood to give SW and CI their distinct place among Portuguese dialects, two decisive questions arise:

a) How large is the contrast between those two areas? This question is based on two facts. 1) The feature considered to be the most remarkable of both varieties, which is used to delimit their geographical areas (Cintra, 1983b:155-158), is the "palatalization" of *u*. That is, both CI and SW share the same main feature. 2) If we consider not only the general dialectal studies (i.e. those that present the fundamental picture of Portuguese dialects by proposing their inventory and classification), many more coincidences can be seen between CI and SW. For example, more or less all features that Segura & Saramago (2001) present to describe SW have been observed to some extent in places inside the CI area (see Brissos, 2012:486ff.).

b) How large is the contrast between those two areas and the rest of CS? The main issue here is that the geodialectal gap between CI and SW is not as strong as a general depiction of Portuguese dialects may present. Some of the characteristic features of both varieties have also been observed in other places. Segura (1987) presents several examples (see also Brissos, 2012:493ff.), the most significant being the "palatalization" of *u*. To a greater or lesser extent this feature, which we have seen is considered to be so prominent in the Portuguese dialectal system as to be identified as the main feature of CI and SW, has been recognized by case studies of many places in continental Portugal from north to south (in insular Portuguese, i.e. in the archipelagos of Azores and Madeira, the feature was noticed from early on). See Segura (1987:290-302) and Santos (2003:121 & 124), who add new data on the Coimbra area.

It is intriguing that there are two idiosyncratic dialectal varieties in CS, especially since the area's linguistic history comprises a dialectal leveling of some sort. But as one goes a step further it becomes clear that dialectal depictions of CS as a whole are needed; the questions that arise from an analysis of the traditional picture of CS include the rationale for two demarcated dialectal varieties and their full characterization.

Auditory / impressionistic (i.e. traditional) dialectology, since it depends on individual perception, has a significant amount of subjectivity. It is particularly limited on difficult matters such as the degree of fronting / backing or closing / opening of a vowel. To deal with this *inherent subjectivity* acoustic data is essential, as it provides quantitative, concrete and eminently objective information.

Both acoustic and traditional dialectology have their own space and provide us with essential data (recalling the words of Ladefoged, 2003:27 cited at the beginning of this paper). For example, the way we speak is influenced by the way we hear the language itself – by our perception. Our goal here is to take advantage of new insights that acoustic data can bring to the characterization of CS, which up to the present has been based only on auditory data.

There is little acoustic data on Portuguese dialects. For CS there is essentially: *a*) Delgado-Martins (2002) (= 1973) and Escudero & Boersma & Rauber & Bion (2009), regarding standard Portuguese or its area; *b*) Segura (1987 and 1989), regarding SW. The following sections will present new data on the matter.

2. Method

2.1. Type of data and comprised geographic area

The data presented in this paper concern F1 (F1 = first formant, and so forth), F2, and F3 Hertz (Hz) values of the stressed vowels of 13 inquiry points in central-southern Portugal, namely the southernmost area; see Map 2 (Appendix, section I). These comprise the ancient provinces of the Algarve, Alentejo, Ribatejo up to the Tagus river, and Estremadura up to the district of Lisbon. That is, the data comprise the districts of Faro, Beja, Évora, Portalegre, Santarém (south from the Tagus), Setúbal, and Lisbon.

The goal is not to delimit a specific area nor to give a full characterization of the language spoken in specific places (in this case, the 13 selected inquiry points), but to study CS in its fully southern parts from a macrodialectal point of view (i.e. to give a dialectal panorama of the select area).

The selected area roughly matches what is traditionally considered to be southern Portugal (south of the Tagus and including Lisbon). It is also a compromise between two necessities that must be balanced; on one hand the need for data from a significant and coherent but not excessively large area.

On the other hand, there is a need to avoid areas where linguistic features that are typically from the north start to appear. Further studies will encompass central and northern Portugal.

The linguistic inquiries were selected so as to give a wide allocation to the area involved, going from south to north in two parallel axes: one near the coastline, the other in the interior. The inquiries were conducted for the Linguistic and Ethnographic Atlas of Portugal and Galicia (ALEPG – *Atlas Linguístico-Etnográfico de Portugal e da Galiza*) project, which is an ongoing project of the Center for Linguistics of the University of Lisbon.[7] Their informants have the classic dialectological profile: they are as traditional / typical as possible in order to be representative of the dialectal variety directly dependent on the respective locale. Thus, the informants have minimal, if any, education, are over 40-50 years-old, have had few, if any, periods of time outside their hometown, etc.[8]

The 13 selected inquiries were conducted between 1973 and 1995. They were phonetically transcribed by the ALEPG team, and this author subsequently studied and listened to them extensively. For each inquiry, a male informant was selected to be the subject of spectrographic measurements. Five main reasons explain the use of only one informant per inquiry point:

a) It is a procedure with a strong tradition in dialectological studies (see, e.g. the international project *Atlas Linguarum Europae* (see its website in References)). ALEPG itself typically uses one main informant per inquiry point, other informants being used to answer to specific parts of the questionnaire (i.e. parts that cannot be answered by the main informant because they involve very specific knowledge, as for example pottery, agricultural implements, etc.).

b) ALEPG data have been used and validated by a great number of dialectal works, be they projects such as the *Syntax-oriented Corpus of Portuguese Dialects*, or specific studies, such as Segura & Saramago (2001). The choice of informants by the ALEPG team was always done with care. ALEPG researchers would spend several days in each town / inquiry point (frequently more than one week), test several speakers and only then choose the most representative of each inquiry point's language and ethnography to be used as informants. The main informant

[7] See more on the project, the data of which are for the most part unpublished, at: the ALEPG website (see References); the inquiry questionnaire, Vol. I (see References); Saramago (2006); Gottschalk (1977).

[8] The ALEPG informants are thus what Chambers & Trudgill (1980) call the NORMs = Non-mobile older rural males, i.e the typical informant used in European dialect studies, with one exception: the ALEPG uses a significant number of female informants, either as main or secondary informants.

would naturally be the most representative. The data I use in this paper always comes from the main informants.

c) As an additional means of data control I listened to every inquiry to its fullest extent and auditorily studied its language. That is, I checked the dialectal validity of every inquiry point to be used in this study. We will see further on that the two inquiry points where the most distinct vowel systems would be expected (Alpalhão, as it belongs to CI, and Praia da Salema, belonging to SW) fully match what could be expected; i.e. Alpalhão and Praia da Salema (i) have the most distinct vowel systems of the set of inquiry points used in this study (ii) exactly in the way we would expect those systems to be. This fact may be interpreted as an additional test that the data passed successfully.

d) As was previously stated, the present study takes on a macrodialectal perspective. It does not focus on specific places or dialects, as its main goal is to provide an overview (a *panoramic view*) of Portuguese southernmost dialects. This paper then, presents data from thirteen speakers of an area defined as belonging to the same *dialectal unity* (CS; recalling what was said in the Introduction), and not from thirteen different dialects or sub-dialects.

e) Using more than one informant per inquiry point would make it necessary to collect new data *in loco*, because the ALEPG *corpus* could not be utilized. Both financial and scientific issues would have to be considered, as ALEPG recordings provide exceptional information on conservative dialectal speech (the type of language required by this study) that would be extremely difficult to obtain nowadays.

The use of a male (not a female) informant is explained simply by dialectological tradition. The large majority of dialectal studies (acoustic or auditory) on Portuguese provide information mostly or exclusively from male speakers. Therefore, in order to obtain comparable data male informants would have to be chosen.

Sets of free, spontaneous conversation were preferably used, and only examples occuring in declarative sentences were collected. The informants were between 48 and 78 years-old (average = 67), without any deviant characteristics such as harelip, lack of teeth, etc.

2.2. Vowel contexts

2.2.1.

Four phonetic contexts have been established, all in CV syllables (which is the most representative type of syllable in Portuguese (Andrade & Viana, 1994; Vigário & Falé, 1994; Viana & Trancoso & Silva & Marques & Andrade & Oliveira, 1996; Vigário & Martins & Frota, 2006) and in world

languages in general (Blevins, 1995; Rousset, 2004: chap. 3, spec. 108-115; MacNeilage, 1998 (*apud* Rousset); Maddieson, 2013)): when the vowel occurs immediately after a bilabial, alveo-dental, palatal, or velar consonant. This means that we have the following consonantal inventory: /p,b,m/; /t,d,n,s,z,ɾ,r,l/; /ʃ,ʒ,ʎ,ɲ/; /k,g/.[9]

For each phonetic context, whenever possible, 7 different examples of each vowel were analyzed for every inquiry; therefore all vowels potentially have 28 different measurements of F1, F2, and F3. There is one exception: the vowel(s) equivalent to standard /e/. For that/those vowel(s), 10 occurrences for each context (thus 40 in total) were analyzed. This was because, unlike standard Portuguese, the ancient diphthong [ej] (e.g., 'leite' = milk, 'ribeiro' = brook, stream) was monophthongized into [e] in all of the selected area (as Leite de Vasconcelos had already pointed out in the beginning of the XXth century for example: Vasconcelos, 1970:93). In some places, that monophthong is different from the remaining etymologic (and standard) [e], so both vowel results were not considered indiscriminately. In this manner, *e* < *ei* always has 3 different samples for each context, representing the excess of 10 – 7 that the vowel(s) corresponding to standard /e/ have in comparison with the other vowels.

For most vowel contexts, all 7 (10) occurrences were easily collected. Some contexts, however, are quite rare in Portuguese (e.g. /ɛ/ or /u/ after a palatal consonant, or /ɛ/ after a velar consonant), therefore, in some inquiries it was not possible to measure all 7 (10) occurrences. For this reason, the final averages of F1, F2, and F3 for each vowel are the result of the arithmetic average = mean of the four contextual averages (i.e. an *average of averages*). That is, they are not the result of all occurrences counted together. The second procedure would favor some contexts over others, which is not our goal. In only one case, however, does the difference between the two types of average exceed 50 Hz: in Mesquita, F2 of /æ/ has +54 Hz in the *average of averages*. And in F1there are never differences of over 25 Hz.

[9] In this way, only two places of articulation that are available in Portuguese have been left out: labio-dental and uvular. In what regards the labio-dental articulation, we could only have two consonants: /f/ and /v/. The second one, however, does not exist in extensive areas of central and northern Portugal, which means that we have only one pandialectal labio-dental consonant in European Portuguese: /f/. In what concerns uvular articulation, the picture is even stricter. The only uvular consonant of EP, /ʀ/, has little existence outside the standard variety; instead of /ʀ/, most dialects use /r/.

A well-known fact regarding the selected set of consonants is that those consonants do not vary in CS significantly from a macrodialectal point of view (see, e.g. Vasconcelos, 1970; Cintra, 1983b). That is to say, it is not because of differences in consonantal production that important differences in vowel production may exist.

2.2.2.

The reported vowel contexts allow for an extensive phonological account of Portuguese dialects, as (i) they comprise almost all EP consonants and (ii) it is a well-known fact (e.g., Ladefoged & Disner, 2012:186ff.) that vowels tend to suffer greater influence from consonants that lie in the same syllable as the vowel itself.

To capture spontaneous and dialectologically reliable speech the use of a predetermined questionnaire is problematic, as it typically limits the informants' opportunity to produce spontaneous, natural speech. Our study poses that problem in an acute manner, due to the fact that it comprises linguistic features that informants may want to avoid at all cost (because they are perceived as *rustic pronunciations* and seem to be on the verge of disappearing). Our goal here is to study conservative (i.e. traditional or typical) speech forms.

In accordance with that and to a lesser extent with the fact that the ALEPG questionnaire has its own purposes, a specific, fully predetermined questionnaire was not used. An effort was made nonetheless, to add more specific contexts to the data in order to add phonetic, phonological, and in a broader sense, dialectal variables. For each of the four predetermined syllabic contexts the following scheme was applied:

1. All vowels except for those that are the equivalents of standard Portuguese /e, ɛ/.

1.1. One occurrence in each of the following contexts (matching the predetermined total of seven occurrences): end position; before another vowel (not a glide); before a bilabial consonant; before a palatal consonant; before a velar consonant; before an alveo-dental consonant; before an alveo-dental liquid consonant. Whenever it is impossible to have all of the contextual diversity (which is rare for bilabial and alveo-dental contexts, the most frequent in Portuguese), alveo-dental consonants are given priority, because they are the most frequent and diverse in Portuguese.

1.2. Vowels that occur in the following syllable should be of different qualities (i.e. not only, for example, /e/, but also /a/, /o/, etc.).

Examples of that list, concerning the vowel /u/ after an alveo-dental consonant include: 'nu' ("naked"), 'lua' ("moon"), 'tubo' ("tube," "pipe"), 'tulha' ("granary"), 'ruga' ("wrinkle"), 'tudo' ("all," "everything"), 'grossura' ("thickness").

2. Vowels that are equivalent to standard Portuguese /e, ɛ/ were set apart. Praia da Salema, Mesquita, and Quintos have, in that regard, quite prominent vowel systems (which we will see in detail in subsection 3.3), making it of interest to look for possible similarities between those

places and the others. Therefore, the same set of contexts that was necessary to describe the vocalic paradigms of those three inquiry points was used for all inquiry points.

2.1. In vowels corresponding to standard /e/ the following set of contexts was used, which comprises ten occurrences (unlike the typical seven occurrences of the other vowels):

2.1.1. Three cases that belong to one or more of these contexts: when an etymologic [e] exists in the following syllable; when an etymologic [i] exists in the following syllable; before a palatal consonant – deally using one case before a palatal consonant and two cases from the other two contexts.

2.1.2. A case of verbal infinitive, thus with a paragogic vowel (due to the fact that only CV syllables are used). This paragogic vowel matches (unstressed) /e/ by default, which is pronounced as [i] or [ɨ].

2.1.3. Three cases with an etymologic [a] or [o] ([u]) – i.e. the vowels that are graphically represented by *a*, *o* – in the following syllable; those vowels and the consonants preceding them should be diverse, and one of those consonants should be an /l/.

2.1.4 Three cases of [e] < [ej] (i.e. three cases representing the monophthongization that ancient [ej] underwent in the entire region). If possible, the first case belongs to one of the contexts seen in 2.1.1, and all three cases belong to three different contexts.

Examples of that list, when the vowel occurs after an alveo-dental consonant are: 'alfinete' ("pin"), 'teve' ("he had"), 'selha' ("tub," "pail"); 'fazer' ("to do") (pronounced like fazer[i]/[ɨ]); 'cedo' ("early"), 'rego' (n.) ("furrow," "gully"), 'muleta' ("crutch"); 'azeite' ("olive oil"), 'areia' ("sand"), 'cesteiro' ("basketmaker").

2.2. To vowels corresponding to standard /ɛ/ this set of contexts was predetermined:

2.2.1. Three cases belonging to one or more of the following contexts: when an etymologic [e] exists in the following syllable; when an etymologic [i] exists in the following syllable; before a palatal consonant; in word final position. Always aiming for contextual diversity.

2.2.2. Four cases with an etymologic [a] or [o] ([u]) in the following syllable, if possible with the same number of cases for each vowel. The consonants preceding that vowel should be different, and one of them should be an /l/.

Some examples of that list, when the vowel occurs after an alveo-dental consonant are: 'percebe' ("he notices," "he understands"), 'dezassete' ("seventeen"), 'Tejo' ("Tagus" river); 'cancela' ("gate"; "he cancels"),

'processos' ("processes" (n.)), 'terra' ("earth," "land"), 'boneco' ("doll," "puppet").

This list was fully feasible in most cases, as the ALEPG inquiries usually have a significant amount of recording time. In any case, the segments that follow every occurrence of every vowel were never left out of any phonological or phonetic analysis.

2.3. Type of recordings and acoustical measurement procedures

Because they aim for good dialectological reliability the recordings were not made in a controlled laboratory environment, such as in soundproof rooms, etc. (although the investigators' best efforts were called for so as to have the best acoustic settings). In dialectology a decisive requirement is to have the least possible interference in the speakers' habits so they can be totally at ease and produce spontaneous speech. To this end, the inquiry recordings were conducted in open spaces, inside informants' homes or at another comfortable setting for the informant, and typically in more than one place for each inquiry.

The fact that the recordings were not conducted in a laboratory environment put important conditions on the acoustic analysis methodology. A particularly painstaking scrutiny of the spectrographic data by the researcher was made necessary.

The following procedure was used.

a) Samples of vowels to be analyzed were collected while listening to the inquiry. All inquiries were fully auditioned, auditorily and acoustically inspected and perceptually analyzed.

Formant measurements were performed in SpeechStation 2, in wide-band spectrograms (64 pt), FFT mode and with a Hanning window of 5,8 ms. Formant values were obtained by using the Spectral Slice tool with the same settings as the main spectrum.

The vowel's stable portion was visually and aurally determined and a selection of the entire stable part was made; that is, for each sample of each vowel its stable portion was selected, leaving aside only formant transitions. Formant values were obtained from the peaks presented by the Spectral Slice tool, which in turn are the product of the average peak values in the selected area. The Spectral Slice tool was thus set in «Average Spectrum» mode, therefore calculating the average values of the set of spectra that form the wide spectrum of the selected recording time.

b) Spectrograms were used with a sample rate of 11025 Hz (Ladefoged, 2003:26, etc.). The ALEPG inquiries were recorded using an analog signal and later digitized to the standard rate of 44100 Hz, so a rate conversion was necessary.

This was done by using Audacity version 2.0.2, performing the following changes to the program's default settings: «Default Sample Format» = 16-bit; «Real-time Conversion» and «High-quality Conversion» = High-quality Sinc Interpolation with dither set to None.

3. Data and discussion

The acoustic data, together with classic vowel charts of F1 and F2, are presented in Appendix section II. In our discussion we will have to focus on the main facts and with few exceptions, on the analyses of general mean vowel results. That is, we will normally abstract away from analyses of the four main selected contexts: bilabial, alveo-dental, palatal, and velar. Therefore, only mean values of vowels are presented in the Appendix; other values, when pertinent, are presented during the course of the text.

Before surveying and commenting the geographical distribution of those facts, some of them need specific remarks.

3.1. Introduction: CS' phonological systems

The data show seven different phonological systems:[10]

1. /i, e, ɛ, a, ɔ, o, u/ (i.e. a system similar to that of standard Portuguese): in Santa Luzia, Zambujeira do Mar, Baldios, Carrapatelo, Foros do Arrão, Cabeço de Vide and Freixial. – Examples: [b'iʎɐ] 'bilha' ("clay pitcher"), [ɐk'i] 'aqui' ("here"); [s'edu] 'cedo' ("early"), [ʒ'elu] 'gelo' ("ice"); [ɐmɐɾ'ɛlɐ] 'amarela' ("yellow" (fem.)), [kuɲ'ɛsɨ] 'conhece' ("he knows"); [m'aɾi] 'mar' ("sea"), [k'azɐ] 'casa' ("house;" "he marries," "he gets married"); [sɐbuɾ'ɔzɐ] 'saborosa' ("tasty" (fem.)), [kaʃ'ɔtɨ] 'caixote' ("box," "case"); [aɬm'osu] 'almoço' (n.) ("lunch"), [sɨɲ'oɾɨ] 'senhor' ("Mr.," "sir;" "owner," "possessor"); [m'udu] 'mudo' ("mute" (masc.)), [r'uɐ] 'rua' ("street").
2. /i, e, ɛ, a, ɔ, o, ʉ/: Foros da Casa Nova. – Examples: this vowel phonemes can be illustrated by the list used in 1, the difference being that 'mudo' and 'rua' would have [ʉ] instead of [u].
3. /i̟, e, e̟, æ, ɒ, ɔ̟, o, ʉ/: Praia da Salema. – Examples: /i̟, ɒ, ɔ̟, o, ʉ/ can be illustrated by the list used in 1 and 2, bearing in mind that those vowels match Praia da Salema's in the following way: /i/↔/i̟/, /a/↔/ɒ/, /ɔ/↔/ɔ̟/, /o/↔/o/, /u/↔/ʉ/. The vowels /e, e̞, æ/ can be illustrated as follows: [p'e̟t] 'peito' ("chest," "breast;" "I bribe"), [s'eɾɐ] 'seira' ("frail," "wicker basket"), [s'e̞d] 'sede' ("thirst"); [p'e̞t] 'peto' ("woodpecker;" a specific part of a pruning-hook), [s'e̞ɾɐ] 'cera' ("wax"), [s'e̞d] 'cedo' ("early"),

[10] Whenever necessary (i.e. regarding vowels or sub-sets of vowels that differ from standard Portuguese), minimal or near-minimal pairs are presented.

[ʒˈe̯l] 'gelo' ("ice," "frost"), [tˈe̯t] 'teto' ("teat," "nipple"); [sˈæt] 'septo' ("septum"), [ʒˈæl] 'gelo' ("I freeze"), [tˈæt] 'tecto' ("ceiling"), [ɐmɐɾˈælɐ] 'amarela' ("yellow" (fem.)).

4. /i, e, ɛ, æ, a, ɔ, o, u/: Mesquita. – Examples: this vowel system can be illustrated by the same list used in 3. Mesquita's vowels correspond to Praia da Salema's in the following way: /i/↔/i̯/, /e/↔/e/, /ɛ/↔/e̯/, /æ/↔/æ/, /a/↔/ɐ/, /ɔ/↔/ɔ̯/, /o/↔/o/, /u/↔/ʉ/.
5. /i, e, æ, a, ɔ̯, o, u/: Quintos. – Examples: this system can be illustrated by the same set of words used in 3 and 4, the difference being that instead of two non-high, non-open front vowels Quintos has only one. That is, where Praia da Salema and Mesquita have respectively /e, e̯/ and /e, ɛ/ Quintos has only /e/. Using the list seen in 3, we get the following scheme: [pˈet] 'peito' ("chest," "breast;" "I bribe"), [sˈeɾɐ] 'seira' ("frail," "wicker basket"), [sˈed] 'sede' ("thirst"), [pˈet] 'peto' ("woodpecker;" a specific part of a pruning-hook), [sˈeɾɐ] 'cera' ("wax"), [sˈed] 'cedo' ("early"), [ʒˈel] 'gelo' ("ice," "frost"), [tˈet] 'teto' ("teat," "nipple"); [sˈæt] 'septo' ("septum"), [ʒˈæl] 'gelo' ("I freeze"), [tˈæt] 'tecto' ("ceiling"), [ɐmɐɾˈælɐ] 'amarela' ("yellow" (fem.)).
6. /i, e, e̯, ɛ, a, ɔ, o, ɵ, ʉ/: Alpalhão. – Differences exist between Alpalhão's system and that of number 2 only in regard to close-mid vowels, in two different ways.
   a) Vowel /ɵ/ comes mainly from the ancient diphthong [ow]. In standard Portuguese, that diphthong evolved to simple [o], not after the XVIII[th] century (Teyssier, 2001:52; Brissos, 2012:305-312, spec. 310-311). /ɵ/ is also the result of [oj] – which is kept unchanged (i.e. [oj] = /oi/) in standard Portuguese – namely in cases where there can be any sort of confusion or alternation between [oj] and [ow].[11]
   b) As was mentioned earlier, throughout the area comprised in this study the historic [ej] (= /ei/), which in standard Portuguese underwent a dissimilatory process to become [ɐj], was monophthongized into [e] (and not to any of the other variants of standard [e] and [ɛ] – the non-high front vowels – that are found in

[11] Confusion / alternation between [ow] and [oj] is a well-known fact of several Portuguese dialects and, in a broader sense, of the history of the Portuguese language; see for example Vasconcelos (1970:91-92 & 93), Vasconcelos (1934:288) or Cintra (1983a). In Brissos (2012) it is clearly seen for the Castelo Branco area (the northern half of CI) that only those cases of historical [oj] that can be identified with contexts of historical [ow] can have a fronted *o*. That is, only historical *oi* that does not occur before a vowel of the same word can have a fronted *o*; e.g., 'joio' ("darnel"), 'moio' (a measure for corn, etc. of about sixty quarters) never have a fronted *o*, unlike e.g., 'coisa' ("thing") < Latin CAUSAM, 'noite' ("night") < Lat. NOCTEM, which can be pronounced with [ɵ] – and with [o] or [ow] in the areas that do not have [ɵ] or in ancient Portuguese itself: cf. Brissos (2012:84-85 & 305-312).

the area: [ɐ̝,ɐ̞,e̞,ɛ,æ]). Alpalhão's /ɐ̞/ is the result of etymologic [e] monophthong.

A full set of examples of Alpalhão's vowels is as follows: [b'iʎɐ] 'bilha' ("ewer"), [ɐk'i] 'aqui' ("here"); [p'et] 'peito' ("chest," "breast;" "I bribe"), [s'eɾɐ] 'seira' ("frail," "wicker basket"), [l'eʃ] 'leis' ("laws"); [p'ɐ̞t] 'peto' ("woodpecker;" a specific part of a pruning--hook), [s'ɐ̞ɾɐ] 'cera' ("wax"), [l'ɐ̞ʃ] 'lês' ("you (sing.) read"), [ʒ'ɐ̞lu] 'gelo' ("ice"); [ɐmɐɾ'ɛlɐ] 'amarela' ("yellow" (fem.)), [kuɲ'ɛs] 'conhece' ("he knows"); [m'aɾ] 'mar' ("sea"), [k'azɐ] 'casa' ("house;" "he marries," "he gets married"); [sɐbuɾ'ɔzɐ] 'saborosa' ("tasty" (fem.)), [kaʃ'ɔt] 'caixote' ("box," "case"); [aɬm'osu] 'almoço' (n.) ("lunch"), [sɨɲ'oɾ] 'senhor' ("Mr.," "sir;" "owner," "possessor"), [p'opɐ] 'popa' ("stern"), [t'ok] 'toco' (n.) ("stump"), [ɐv'o]/[v'o] 'avô' ("grandfather"), [m'or] 'morro' ("I die"); [p'ɵpɐ] 'poupa' ("hoopoe," "topknot"), [t'ɵk] 'touco' (a type of cap), [v'ɵ] 'vou' ("I go"), [m'ɵɾ] 'mouro' ("Moorish" (masc.), "Moor"); [m'ʉd] 'mudo' ("mute" (masc.)), [r'ʉɐ] 'rua' ("street").

7. /i, e, ɐ̝, ɛ, a, ɔ, o, u/: Alcochete. – Alcochete's system differs from Alpalhão's in that (i) it has no /ɵ/ and (ii) to Alpalhão's /ɐ̞/ and /ʉ/ correspond Alcochete's /ɐ̝/ and /u/, respectively. That is, /i, e, ɛ, a, ɔ/ have perfect matches between Alcochete and Alpalhão. A full list of examples excluding /i, e, ɛ, a, ɔ/ is as follows: [p'ɐ̝t] 'peto' ("woodpecker;" a specific part of a pruning-hook), [s'ɐ̝ɾɐ] 'cera' ("wax"), [l'ɐ̝ʃ] 'lês' ("you (sing.) read") (*versus* [p'et] 'peito' ("chest," "breast;" "I bribe"), [s'eɾɐ] 'seira' ("frail," "wicker basket"), [l'eʃ] 'leis' ("laws")), [ʒ'ɐ̝lu] 'gelo' ("ice"); [aɬm'osu] 'almoço' (n.) ("lunch"), [sɨɲ'oɾ] 'senhor' ("Mr.," "sir;" "owner," "possessor"), [p'opɐ] 'popa' ("stern"), [t'ok] 'toco' (n.) ("stump"), [ɐv'o]/[v'o] 'avô' ("grandfather"), [m'or] 'morro' ("I die"), [p'opɐ] 'poupa' ("hoopoe," "topknot"), [t'ok] 'touco' (a type of cap), [v'o] 'vou' ("I go"), [m'oɾ] 'mouro' ("Moorish" (masc.), "Moor"); [m'ud] 'mudo' ("mute" (masc.)), [r'uɐ] 'rua' ("street").

There are seven inquiry points with phonological systems that are coincident with that of standard Portuguese (grouped in 1) and six with different systems. Map 3 (Appendix section I) shows the respective geographical distribution.

See also Table I where a comparison is made vowel by vowel between standard Portuguese and the six inquiry points that have different vowel systems.

Table I. Standard Portuguese vs. different vowel systems.

Standard Portuguese	Foros da Casa Nova	Praia da Salema	Mesquita	Quintos	Alpalhão	Alcochete
/i/	=	/i̞/	=	=	=	=
/e/	=	/e/,/e̞/	/e/,/ɛ/	/e/	/e/,/ə̞/	/e/,/ë/
/ɛ/	=	/e̞/,/æ/	/ɛ/,/æ/	/e/,/æ/	=	=
/a/	=	/ɒ/	=	=	=	=
/ɔ/	=	/ɔ̞/	=	/ɔ̞/	=	=
/o/	=	=	=	=	/o/,/ɵ/	=
/u/	/ʉ/	/ʉ/	=	=	/ʉ/	=

In the following subsections we will see details on specific vowels that are different from standard Portuguese.

3.2. Standard Portuguese /u/(i.e. vowels that correspond to standard /u/ = [u])

Perhaps the most interesting facts regarding specific vowels that are shown by our data lie within the variation of *u*, which, as we have seen, is considered to be the most prominent feature of the idiosyncratic dialectal varieties of CI and SW.

To begin, one should note the existence of a central *u* not only in SW (Praia da Salema) and CI (Alpalhão) where it is expected, but also in Foros da Casa Nova, where it is not, according to traditional descriptions of the Portuguese dialectal system (as was seen in the Introduction).

In all other inquiry points we have [u] (i.e. a back vowel) like standard Portuguese. In standard Portuguese, however, [u] is the vowel with the lowest value of F2 (Delgado-Martins, 2002; Escudero *et al.*, 2009), that is, the vowel that occupies the rearmost place in the set of available articulations. In 6 of the 10 inquiry points of CS that have [u], [u] is not the vowel with the lowest value of F2. And in 2 of the 4 places where [u] has the lowest F2, the difference between [u] and [o] (the vowel that has the second lowest F2 in all 4 inquiries, as was to be expected) is insignificant; in Freixial, [u] has the same acoustic space of F2 as [o] (0%),[12] and in Foros do Arrão [o] has only 1% of the acoustic space of F2 ([u] having, naturally, 0%).

[12] Acoustic space being the range of possible articulations (as measured in Hz values) from the vowel with the lowest Hz value to the vowel with the highest Hz value of the respective vowel system. For example, if [u] F2 = 1000 Hz and is the lowest of its vowel system ([u] being, thus, the rearmost vowel), and [i] F2 = 2500 and is the

Table II shows the acoustic space of F2 of non-front vowels in each of the 13 inquiry points and in standard Portuguese. It can be seen that [o] always occupies a more backed position than [ɔ]/[ɔ̟], and [ɔ]/[ɔ̟] are always more backed than [a]/[ɒ]. That order is kept in the remaining vowels – with the natural exception of Alpalhão's [ɐ̟], which is more retracted than [ɛ] –, so the matter at hand is really a fronting of *u*, not an extreme backing of other vowels.

From the table it is evident that despite not being the most posterior vowel of the respective system *u* is effectively [u] in all inquiries but in Praia da Salema, Foros da Casa Nova and Alpalhão, and not a central *u*. Centralized *u*, [ʉ], exists in those three places, but in Praia da Salema it has a considerably larger acoustic space of F2 (52%); in the other two places it has exactly the same value (22%).

I chose [ʉ] and not [y] to represent Salema's *u* because it occupies a central position, not a true front position. It has 52% (that is, half) of the acoustic space of F2, and one can see in Salema's formant chart that its *u* is in a central position.

Nonetheless, [y] would not be an illogical choice to represent Salema's *u*, because it is only in bilabial context that the vowel is not a true front vowel. It has 1171 Hz = 25% of the acoustic space of F2 in that context and 1794 Hz = 64% in the mean of the other three contexts.[13] Examples: [m'uɾ]/[m'ʉɾ] 'muro' ("wall"), [dɨb'uʌ̃]/[dɨb'ʉʌ̃] 'debulham' ("they thresh") *versus* [d'yɾ] 'duro' (adj.) ("hard," "tough"), [kɨɾ'yʒɐ] 'coruja' ("owl"); [ʒ'yɾʃ] 'juros'

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highest ([i] being the more fronted vowel), [u] has 0% of the acoustic space of F2, whereas [i] has 100%; the total acoustic space of F2 of that vowel system goes from 1000 to 2500 Hz, thus being of 1500 Hz. If [o] F2 = 1100 Hz, [o] has 7% of the acoustic space of F2, as 1100 – 1000 = 100 (the difference between [o] and the vowel with the lowest F2), and 100 / 1500 = 0,066 * 100 = 6,6 = 7.

[13] The (rounded) values behind those averages are: 1, After bilabial consonants, *u* has, as was indicated, 1171 Hz; the rearmost vowel, /o/, has 854 Hz. – 2.1, After alveo-dental consonants, *u* has 1807 Hz and /o/ has 1078 Hz; 2.2, after palatal consonants, *u* = 1815 Hz, /ɔ̟/ (which, in this context, is the backmost vowel) = 1174 Hz; 2.3, after velar consonants, *u* = 1760 Hz, /ɔ̟/ (once again the rearmost vowel) = 982 Hz. – 3, The contextual acoustic spaces of F2 are: bilabial context, 1285 Hz; alveo-dental context, 1109 Hz; palatal context, 1037 Hz; velar context, 1223. – Thus, for the combined context of alveo-dental + palatal + velar we have [((1807 + 1815 + 1760) / 3 = 1794) – ((1078 + 1174 + 982) / 3 = 1078) = 716] / [((1109 + 1037 + 1223) / 3 = 1123)] = 0.64 * 100 = 64% of the acoustic space of F2;

(a) $$\frac{\frac{\sum_{i=1}^{n=3} U_i}{n} - \frac{\sum_{j=1}^{p=3} RMV_j}{p}}{\frac{\sum_{l=1}^{q=3} AS_l}{q}} = 64\%$$

that is, (a), where U is the vowel *u*, RMV the rearmost vowel, and AS the acoustic space of F2.

("interest (rate)"), [ɐʒ'ydɐ] 'ajuda' ("help"); [k'yk] 'cuco' ("cuckoo"), [pɾok'yɾɐ] 'procura' ("he searches (for)," "he seeks").

Table II. Percent of the acoustic space of F2 of non-front vowels in the respective phonological systems.

All non-front vowels show up on the table except [ɵ], which only exists in one inquiry point (Alpalhão) and has 31% of the acoustic space of F2 of that inquiry. – Phonological systems in which *u* is the rearmost vowel are marked with grey shading. – In order to compare our data with that of Escudero *et al.* (2009) which are presented in geometric averages, results built from the geometric averages of our data are presented whenever there is a difference between that type of average and the arithmetic average which was always used in this paper (that difference is never higher than 1%, be that -1 or +1 %). Results built from geometric average values are presented in parentheses. – Standard Portuguese-1 = standard Portuguese as depicted by Delgado-Martins (2002/1973). Standard Portuguese-2 = standard Portuguese (or the Portuguese spoken in the European Portuguese norm geographical area) as depicted by Escudero *et al.* (2009).

	[a]	[ɒ]	[ɔ]	[ɔ̟]	[o]	[u]	[ʉ̟]
Praia da Salema		18		1 (2)	0		52 (51)
Santa Luzia	42		10		8 (7)	0	
Zambujeira do Mar	28 (29)		1		0	9	
Mesquita	26		4 (5)		4	0	
Foros da Casa Nova	38		4		0		22
Quintos	38			6	0	11 (10)	
Baldios	30		7		0	2 (1)	
Carrapatelo	32		5		0	8	
Alcochete	29		8		0	11	
Foros do Arrão	36		13		1	0	
Cabeço de Vide	36		6		0	1 (2)	
Alpalhão	40		11 (10)		0		22
Freixial	30		6		0	0	
MEAN	*34*	**18**	*7*	*4*	*1*	*4*	*32*
Standard deviation	*5*	**0**	*3*	*4 (3)*	*2*	*5*	*17*
Standard Portuguese – 1	39		19		11	0	
Standard Portuguese – 2	41		9		2	0	

Table III and figure 1 systematize the respective data.

Table III. Praia da Salema contextual vowel values
(Hz, mean values; standard deviations in parentheses).

Context-1 = when the vowel occurs after a bilabial consonant. Context-2 = when the vowel occurs after an alveo-dental, palatal, or velar consonant. Four standard deviations are presented in this case: the first three reporting to each of the referred three contexts, and a fourth reporting to the combined average of those contexts.

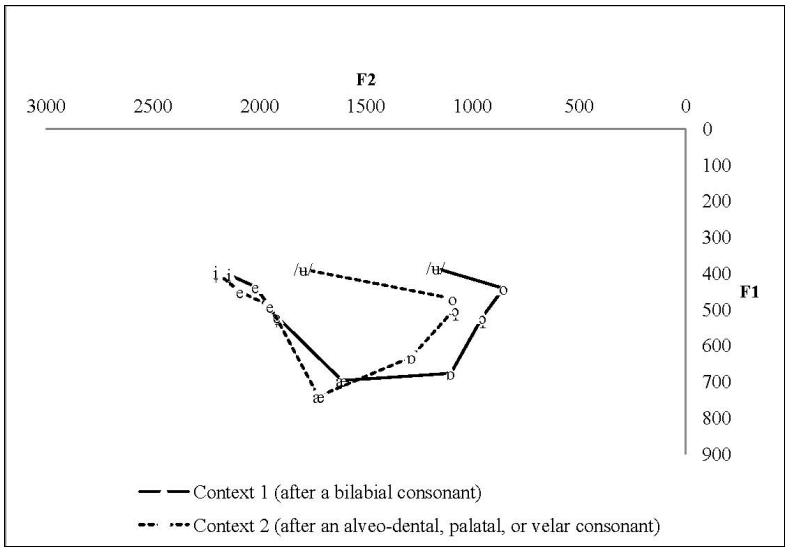
	F1		**F2**	
	Context-1	Context-2	Context-1	Context-2
/i̱/	405 (44)	397 (31,52,65; 11)	2139 (105)	2201 (109,63,198; 13)
/e/	437 (36)	451 (34,11,42; 16)	2019 (133)	2092 (69,117,111; 122)
/e̱/	520 (42)	490 (42,90,0; 30)	1918 (95)	1950 (63,99,104; 97)
/æ/	697 (48)	741 (38,0,28; 46)	1613 (144)	1723 (86,0,28; 95)
/ɒ/	677 (105)	632 (53,75,112; 36)	1102 (95)	1287 (140,110,150; 63)
/ɔ̱/	520 (48)	497 (35,15,30; 21)	953 (105)	1081 (102,108,104; 96)
/o/	442 (30)	470 (19,44,45; 25)	854 (44)	1093 (59,181,84; 114)
/ʉ/	386 (55)	389 (56,26,29; 20)	1171 (264)	1794 (111,331,63; 30)

There are other interesting facts regarding the contextual variation of CS's *u* – above all, the recurring dissimilarity between the bilabial context and the other three contexts: the first tends to push *u* back, as in Salema –, but they must be seen on a different occasion. It can be said, nonetheless, that none of them has implications on the *u* timbre, i.e. none of them cause *u* to have a different vowel quality in any of the inquiry points.

Regarding SW, it should be noted that Segura (1987:221-316) finds, as we did, a wide range for *u* articulations, going from pure [u] to sheer [y]. Segura does not find, however, a specific contextualization that can explain that variation. Our data – which are not as detailed in context control as Segura's – point to a strong distinction of bilabial context: after a bilabial consonant *u* loses most of its fronted / palatalized nature, which in the other contexts is robust and constant.[14]

[14] Apart from the bilabial context, the lowest F2 value of the Salema *u* in our data is found in the velar context (as would probably be expected). But it is only -55 Hz from the highest value, 1815 Hz, which is found in the palatal context.

Figure 1. Praia da Salema: vowels according to context (Hz, mean values)



For now, the most important fact to point out is that, unlike the standard Portuguese *u*, the typical central-southern dialectal *u* is not the most posterior vowel of the respective phonetic / phonological system. That is to be expected in two of the inquiry points that we use (Praia da Salema and Alpalhão), but two facts are new and unforeseen data. First the existence of [ʉ] in another inquiry point (Foros da Casa Nova); secondly, the clear tendency across the selected area for *u* to escape the rearmost position.

Only in four inquiry points is *u* the most posterior vowel; in seven of the remaining nine inquiry points, *u* is not only more fronted than [o], but also more than [ɔ]/[ɔ̟], the remaining back vowel(s) (apart from Salema's [ʊ]). And, as was previously mentioned, in two of the four places where *u* has the shortest acoustic space of F2 the difference between it and [o] is insignificant.

The standard Portuguese vowel system is known as an articulatory--acoustic triangle, in which there is a constant backing from *i* to *u*; CS, as depicted by our data, verifies that pattern only from *i* to close *o*, as *u* tends to not be the rearmost vowel.

There is an evident pattern that there is not such a great gap between the idiosyncratic dialectal varieties of CI and SW and the whole of CS as one would suppose from traditional data (remember what was said in the Introduction). There are significant similarities across the entire CS that should have strong consequences on the way we understand the genesis of those two varieties in the whole of CS.

This understanding is only revealed by using acoustic data, as some details (such as the exact placing of *u* in the acoustic space of F2) are too difficult to grasp auditorily.

The fact that CI and SW are not as distinct from the rest of CS as might be supposed is evidenced from more of our data. We will now consider them.

3.3. Standard /e, ɛ/: opening / closure

When we take into consideration the vowel system found at Praia da Salema (which typifies SW), we observe that the standard Portuguese /e/ is represented by two vowels: /e/ and /e̯/. The first is the result of: the monophthongization of ancient [ej]; and of the etymologic monophthongal [e] when: (i) it occurs in word final position; (ii) it occurs before a palatal consonant; (iii) there exists or has existed an unstressed /e/ or /i/ (nowadays pronounced [ɨ], if pronounced at all) in the following syllable. The vowel /e̯/ is the result of the remaining etymologic stressed [e] monophthong. Examples: p['e]to 'peito' ("chest," "breast"), [v'e] 'vê' ("He sees"), conc['e]lho 'concelho' ("municipality," "council"), fogu['e]tes 'foguetes' ("rockets") *versus* b['e̯]bado 'bêbado' ("drunk"), s['e̯]co 'seco' ("dry" (masc.)).

Standard /ɛ/ too is divided by Salema's dialect into two separate vowels: /e̯/ and /æ/, which have a similar contextualization to /e, e̯/ ↔ standard /e/. In word final position, before a palatal consonant or when there exists or has existed etymologic unstressed /e, i/ in the following syllable, standard /ɛ/ is pronounced /e̯/; in the remaining contexts, standard /ɛ/ is pronounced as the open vowel /æ/. Examples: balanc['e̯] 'balancé' ("seesaw"), m['e̯]xes 'mexes' ("you (sing.) stir"), l['e̯]bre 'lebre' ("hare") *versus* p['æ]dra 'pedra' ("rock"), qu['æ]ro 'quero' ("I want").

In 3.1 we have seen examples of minimal pairs that allow us to postulate that /e, e̯, æ/ are different phonemes. See also other examples, and a full discussion by Segura (1987:342:348) which deals with the same vowel system as Salema's and establishes the same phonemic inventory.[15]

Salema's system is typical of the area to which it belongs – the SW. In Mesquita we have an identical system, except for the fact that, instead of mid *e* /e̯/, it has open-mid /ɛ/.

In Quintos, which is close to Mesquita, there are only two non-high front vowels: /e/ and /æ/. There is an obvious similarity with Salema and Mesquita: /æ/ has the same contextual distribution as in those two places, and /e/ is equivalent to Salema's and Mesquita's /e/ and /e̯~ɛ/.

Nonetheless, Quintos /e/ has an interesting distribution. If we apply the same contextualization to Quintos /e/ that is suitable to Salema's and Mesquita's /e/, /e̯~ɛ/ , it can be seen that F1 values rise continuously from one context to the other: *e* < *ei* = 414 Hz (sd, 24) (F2 = 2084 Hz; sd, 55), *e* – *e,i* / + palatal cons. = 439 Hz (sd, 50) (F2 = 2005 Hz; sd, 165), and the

[15] The only difference is that instead of /e̯/ Segura finds /ɛ/, which is a phonetic fact (both vowels occur in the same contexts) and not a very significant one.

remaining *e* = 480 Hz (sd, 14) (F2 = 2036 Hz; sd, 110). The third context has double the acoustic space of the first for F1: 32% *vs*. 16%.

We can, therefore, find a parallel between Quintos on one hand, and Salema and Mesquita on the other. In Quintos there is an equivalent contextual opening (or closure, if we see it from the opposite perspective) of Salema and Mesquita's opening / closure. In Quintos, however, that variation is not strong enough to produce a real different vowel quality throughout the three contexts we must take into consideration.

Does that parallel mean that Quintos is subject to the same system as Salema and Mesquita? It seems a likely hypothesis, given the fact that: (i) Quintos is the only place, along with Salema and Mesquita, that has the open vowel /æ/ (and the only with /ɔ̟/, alongside Salema); and (ii) Quintos is geographically close to Mesquita.

There are no comparable data in the remaining inquiry points, as is evident from Table IV. The table does not include Salema, Mesquita, and Quintos, the data from which were already analyzed, and Alcochete and Alpalhão, which have different issues pertaining to standard /e/ (we will see them in 3.4).

Table IV. Mean values: F1, F2 (standard deviations in parentheses).

	[e] < *ei*	[e] – *e,i* / + palatal cons.	remaining [e]
Santa Luzia	471, 2039 (33, 16)	461, 2021 (19, 77)	468, 1957 (28, 70)
Zambujeira do Mar	448, 1731 (21, 112)	428, 1549 (40, 77)	463, 1675 (10, 73)
Baldios	480, 1935 (44, 112)	488, 1848 (15, 128)	484, 1895 (25, 64)
Carrapatelo	450, 2219 (9, 167)	461, 2038 (12, 152)	469, 1976 (29, 149)
Foros do Arrão	508, 1967 (34, 161)	547, 1877 (37, 88)	534, 1861 (18, 110)
Cabeço de Vide	474, 1908 (21, 122)	470, 1888 (21, 97)	465, 1846 (22, 111)
Freixial	441, 1815 (12, 43)	435, 1790 (15, 29)	447, 1757 (9, 52)
Foros da Casa Nova	506, 1814 (55, 70)	518, 1797 (24, 162)	488, 1818 (13, 109)
Mean	*472, 1929 (25, 153)*	*476, 1851 (40, 153)*	*477, 1848 (26, 100)*

The same cannot be said of standard /ɛ/ equivalents, i.e. of Salema, Mesquita, and Quintos /æ/ and /e̝/~/ɛ/~/e/ (according to the contextualization we have seen). Table V presents the relevant data.

Table V. Mean values: F1, F2 (standard deviations in parentheses).

	[ɛ] – *e,i* / + palatal cons.	remaining [ɛ]
Santa Luzia	589, 1880 (30, 114)	606, 1825 (18, 19)
Zambujeira do Mar	503, 1608 (27, 18)	582, 1535 (13, 41)
Baldios	546, 1771 (25, 103)	604, 1676 (22, 96)
Carrapatelo	560, 1892 (13, 41)	590, 1785 (28, 56)
Foros do Arrão	651, 1703 (35, 60)	690, 1737 (19, 126)
Cabeço de Vide	580, 1755 (25, 60)	599, 1771 (27, 155)
Freixial	535, 1627 (23, 90)	558, 1552 (22, 74)
Foros da Casa Nova	619, 1772 (25, 83)	629, 1607 (34, 63)
Alpalhão	523, 1939 (14, 34)	545, 1965 (15, 67)
Alcochete	559, 1786 (31, 108)	612, 1655 (82, 138)
Mean	*567, 1773* *(45, 109)*	*602, 1711* *(40, 133)*

Small as the differences are in some cases, it is significant that the same contextual *e* that is pronounced open [æ] also has a more open pronunciation than the other contextual *e* in all of the remaining inquiries.

Zambujeira do Mar, Baldios, and Alcochete differentiate from the rest, as one can deduce the existence in those places of the phoneme /ɛ/ with the allophones [e̝] or [ɛ̝] and [ɛ] or [ɛ̞]. This becomes apparent if we observe the average F1 differences between vowels in those places: see Tables VI-I and VI-II. One can, for example, compare the differences between the two contextual *e* (i.e. the two types of equivalents to standard and historic /ɛ/ that

are being taken into consideration) with the differences between the remaining front vowels, or the differences between /u/ and /o/, etc..

Table VI-I. F1 differences between vowels.

	i → e	e → ɛ-1	ɛ-1 → ɛ-2	ɛ-2 → a	a → ɔ	ɔ → o	o → u	*Average difference*
Zambujeira do Mar	83	52	79	89	-136	-87	-69	*85 (sd = 26)*
Baldios	97	70	58	127	-163	-107	-66	*98 (sd = 38)*

Table VI-II. F1 differences between vowels.

	i → e	e→ ɐ̟	ɐ̟ → ɛ-1	ɛ-1 → ɛ-2	ɛ-2 → a	a → ɔ	ɔ → o	o → u	*Average difference*
Alcochete	62	51	92	53	164	-223	-112	-74	*104 (sd = 61)*

These data are clearly significant, as they indicate a *dialectal constant* – opening or closure of standard and historic /ɛ/ – that is maximized in specific areas; Praia da Salema, Mesquita, and Quintos, on one hand, and Zambujeira do Mar, Baldios, and Alcochete, on the other. These areas are not geographically continuous.

Altogether our data show that the clash between standard /ɛ/ and the idiosyncratic dialectal variety of SW should be seen in a fully *macrodialectal* perspective. The clash is not as apparent as it may seem from traditional data, which, depending on individual perception, can only go up to a certain point.

3.4. Standard /e/: velarization (i.e. backing or centralization) and lip rounding

In Alpalhão, the ancient diphthong [ej] (which, in standard Portuguese, is pronounced [ɐj]) has, as in all other inquiry points, the monophthongized pronunciation [e]. The etymologic [e] monophthong, to the contrary, has a centralized pronunciation: [ɐ̟]. Examples: prim['e]ro ‘primeiro’ (“first” (masc.)), l['e]te ‘leite’ (“milk”), b['e]jos ‘beijos’ (“kisses”) *versus* cab['ɐ̟]lo ‘cabelo’ (“hair”), g['ɐ̟]lo ‘gelo’ (n.) (“ice”), t['ɐ̟]ta ‘teta’ (“teat”).

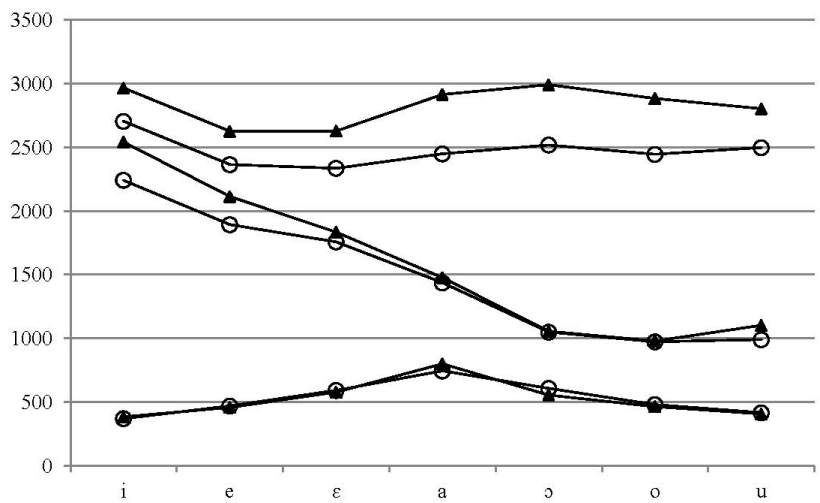
Such a dissimilarity between *e* < *ei* and the remaining close-mid *e* is to be expected in the area to which Alpalhão belongs (Ferreira, 1996:23; Brissos, 2012:59). Not to be expected, according to traditional data, is the existence of a similar feature in Alcochete. There, parallel to [ej] > [e] (with exactly the same distribution), we have the pronunciation of the etymologic [e] monophthong as [ɐ̟]. Accordingly, if we use the same set of examples cited for Alpalhão we will have: prim['e]ro ‘primeiro’ (“first” (masc.)), l['e]te ‘leite’ (“milk”), b['e]jos ‘beijos’ (“kisses”) *versus* cab['ɐ̟]lo ‘cabelo’ (“hair”), g['ɐ̟]lo ‘gelo’ (n.) (“ice”), t['ɐ̟]ta ‘teta’ (“teat”).

Alcochete's is not as strong a backing as Alpalhão's. Whereas Alpalhão's [ᵩ] is a purely central vowel as it is positioned at 49% of the acoustic space of F2, Alcochete's [ë] is positioned at 67% of the acoustic space of F2 (that is, [ë] lies at 33% from [i], the vowel that occupies 100% of the acoustic space of F2). But [ë] is still, evidently, a significantly backed / centralized vowel (as one can see from the respective vowel chart).

None of the remaining inquiry points present similar data, but there are facts that can be related (and once again cannot be predicted from traditional dialectal depictions).

In Cabeço de Vide and Carrapatelo both non-high front vowels (/e, ɛ/) can be aurally perceived as having a slight lip rounding, without any apparent contextual distribution. Formant measurements of those places concur with that perception as F3 values of the referred vowels are, unlike the general behavior of CS, markedly low and close to the respective F2 values; see Figure 2, which presents charts of F1, F2, and F3 of those inquiry points. In front vowels such as the ones at hand, this fact is in accordance with a slight rounding and also with a possible rhotacized pronunciation (cf. e.g. Fant, 1970:113-125; Ladefoged, 1996:131-135; Stevens, 2000:290-294; Lindblom & Sundberg, 2007:687-695; Ladefoged & Disner, 2012:46 & 178-181), which at a perceptual level is more difficult to assess than rounding itself. I do not use a specific symbol for Cabeço de Vide and Carrapatelo's *e* vowels because their different behavior is only moderate and is pointed in our analysis. Nonetheless, a stricter phonetic transcription could easily make use of a specific symbol.

Figure 2. Cabeço de Vide (circles) and Carrapatelo (triangles):
F1, F2 and F3 (Hz, mean values)



Although they are acoustically and auditorily different phenomena, it is clear that the facts noticed in Alcochete and Alpalhão, on one hand, and in Cabeço de Vide and Carrapatelo on the other are analogous and can be related. Impressionistically (auditorily) one can say that they sound similar (although not identical). In fact, the relation between vowel backness and roundedness is a well-known feature of world languages; unlike front vowels, back vowels tend to be rounded (Ladefoged & Maddieson, 1996:292-298; Ladefoged & Disner, 2012:178-181).

Such an analogy becomes even more interesting when we take into consideration three facts: (i) Cabeço de Vide is the closest inquiry point to Alpalhão; (ii) Carrapatelo is the immediate inquiry point to the south of Cabeço de Vide; (iii) Alpalhão, Cabeço de Vide, and Carrapatelo form a continuous line from north to south in the east of CS. Therefore, we are able to find what could be a geographic and genetic consistency.

Additionally, it is important to understand whether Cabeço de Vide and Carrapatelo present the same contrast as Alcochete and Alpalhão between historic [ej] and [e]. Related to this, we should too look at all the other inquiries. Table VII presents the respective data using the same three contexts that were pertinent to the analysis of the opening / closure of the vowel at hand (3.3). It shows us the values of F3 and F3 minus F2.

As can be seen, (i) *e* < *ei* generally does not have high values of F3, and it is the context that has the highest F3 values the least times; apart from Alpalhão and Alcochete, in which one can expect it, only in Quintos and Carrapatelo does *e* < *ei* have the highest values of F3. (ii) *E* < *ei* has the shortest difference of all three contexts between F3 and F2 in eight out of thirteen inquiry points; and it has the shortest difference also, *ex aequo* with the second context, in one of the remaining five inquiries (Santa Luzia). Only in one inquiry (Praia da Salema) is the difference between F3 and F2 values of *e* < *ei* the largest of all contexts; and in another inquiry (Quintos) it is almost identical to the largest difference (it has only -2 Hz, which is insignificant). Mean values themselves indicate the most frequent order of F3 – F2 in all inquiry points: *e* < *ei* has the shortest difference, followed by the third context (the second context thus having the largest difference).

Consequently, the *e* < *ei* context not only fails to take on a detached position by having low rounding but also stands out from the rest for exactly the opposite reason – its low F3 and F3 minus F2 values. This tells us that the rounding or rhotacizing feature that we find outside Alpalhão and Alcochete does not typify the same specific feature that is found in those two places. But it obviously cannot contradict the linguistic and dialectal connection we may establish between the two features.

That connection is also not contradicted by the fact that, unlike what happens in Alpalhão and Alcochete, in Cabeço de Vide and Carrapatelo the relevant feature takes on both /e/ and /ɛ/ (in Alpalhão and Alcochete it leaves out /ɛ/). Indeed, the same *velarization* that can be noticed in Alpalhão and

Alcochete has also been registered in several places of CI (to which Alpalhão belongs), in both close-mid and open-mid *e* – i.e. in both standard /e/ and /ɛ/ (cf. Brissos, 2012:17-25, 61 (and 481-499)).

Table VII. F3 (mean values; standard deviations in parentheses) and F3 – F2.

	[e] < *ei*		[e] – *e,i* / + palatal cons.		remaining [e]	
	F3	F3-F2	F3	F3-F2	F3	F3-F2
Santa Luzia	2584 (41)	545	2566 (76)	545	2590 (25)	633
Zambujeira do Mar	2472 (107)	741	2546 (78)	997	2476 (82)	801
Baldios	2518 (94)	583	2573 (28)	725	2506 (59)	611
Carrapatelo	2685 (43)	466	2584 (137)	546	2589 (39)	613
Foros do Arrão	2700 (64)	733	2765 (46)	888	2670 (75)	809
Cabeço de Vide	2386 (103)	478	2308 (191)	420	2395 (95)	549
Freixial	2257 (35)	442	2308 (43)	518	2232 (51)	475
Foros da Casa Nova	2430 (60)	616	2444 (138)	647	2388 (67)	570
Praia da Salema	2701 (50)	645	2705 (14)	610	2563 (140)	618
Mesquita	2676 (40)	555	2708 (174)	625	2721 (104)	753
Quintos	2734 (121)	650	2657 (158)	652	2585 (57)	549
Alpalhão	2766 (46)	650	2581 (67)	968	2513 (49)	937
Alcochete	2566 (44)	485	2438 (16)	602	2379 (133)	665
Mean		*584 (99)*		*673 (177)*		*660 (130)*

4. Survey of results and further work

Maps 3 to 6 present a geographic outline of the main phenomena our data comprise. Two main facts are to be deduced from the data: *a*) central--southern Portuguese dialects are less heterogeneous than is traditionally supposed; *b*) acoustic dialectology, despite having very little tradition (in Portugal and in most countries), is of great importance. This is so because our data, which only comprise thirteen inquiry points, are able to revise some important issues of Portuguese dialectology.

The following features, which we have seen in detail in Data and discussion, present elucidatory examples:

1. the existence of velarized *e* not only in Alpalhão, where we would expect it, but also in Alcochete;
2. the relatable existence of lip rounding in both non-high front vowels in Carrapatelo and Cabeço de Vide;
3. the significant discrepancy of /ɛ/ between two sets of contexts in places like Baldios or Alcochete, and the same contextual divergence in all inquiry points in which /ɛ/ is not split into two really different allophonic sounds;
3. the existence of a centralized *u* (/ʉ/) outside the idiosyncratic dialectal varieties of CI and SW (in Foros da Casa Nova);
4. the largely dominant tendency of all CS to not place stressed *u* in the backmost position of the vowel system. No more than four out of thirteen inquiries have *u* as the rearmost vowel – Santa Luzia, Mesquita, Foros do Arrão, and Freixial –, and in two of them virtually with no difference from /o/ – Freixial and Foros do Arrão. Only in two of those nine inquiries is *u* the second rearmost vowel (Cabeço de Vide and Baldios); in all other seven places *u* is the least backed of all posterior vowels. It is only in Praia da Salema and Alpalhão that we would expect such a behavior of *u*.

Taken as a whole, apart from the cases of Praia da Salema and Alpalhão in number 5, none of these features have been noted in traditional studies on the inventory and classification of Portuguese dialects. Most of them are only efficiently accounted for through acoustic data due to three complementary aspects (recalling what was said at the end of the Introduction). First is the inherent certainty of a materialistic analysis such as an acoustic one. Second, the quantitative approach made possible by such data. Third, in a broader sense, the fact that acoustic data go beyond the human ear; that is, the human ear is not as precise as improved acoustic resources.

We can, therefore, advance interesting information on the questions posed in the Introduction: How large is the contrast between CI and SW? And how large is the contrast between those two areas and the rest of CS? In general terms, it is clear that those contrasts are by no means as significant as traditional studies lead us to think. Central-southern dialects are less diverse than is usually thought. In fact, many of the prominent features of CI and SW are found outside the respective areas; one can see that all five examples in the list above consider those features.

This brings new dimensions into the history of the Portuguese language. We can deduce that the prominent varieties of CI and SW should not be seen as isolated events in the history of Portuguese, as they are traditionally seen.

Cf. Brissos (2012:25-26 & 493-499) for an explanation of the several different proposals that have been made to account for the existence of such varieties in central-southern Portugal. The proposals can be assembled into two main groups: (i) the proposals that understand the origin of CI and SW in terms of an external influence, i.e. as due to factors that are external to the language itself (substratum – namely Celtic influence on what would become the Portuguese-speaking area – or superstratum – mostly French medieval influence, regarding the high importance of French military orders during the Reconquista in southern Portugal); (ii) the proposals that see peculiar CI and SW features as due to internal developments of the linguistic system (on what can be seen as the *internal systemic economy*).

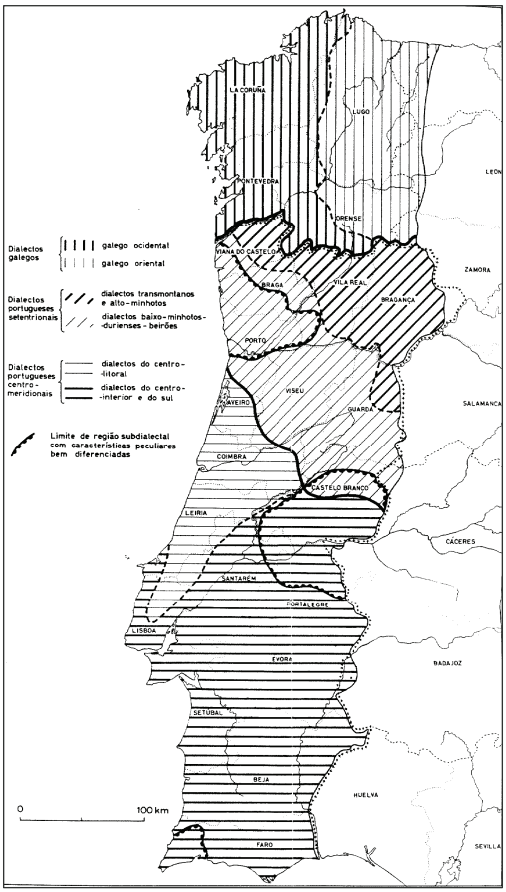
Those proposals need to be revised because as we have seen, acoustic data allow for new approaches. One can say that the geographic gap between CI and SW is like a bridge, and in several features the detached vowel systems of those areas appear to belong to superior central-southern Portuguese tendencies. That is, those vowel systems seem to be dependent on general or broader linguistic processes.

On the other hand, it is important that the network of acoustic data of Portuguese dialects be increased in order to investigate possible connections throughout CS or other areas. We should examine for example why standard Portuguese, which is located in the central-southern area (but represents a language that was born in the northwest of the Iberian Peninsula), diverges from central-southern dialects in so many important aspects (such as the fronting of *u*, the opening or closure of high non-front vowels, etc.). But, above all, we should bring new tangible data on Portuguese dialects, and we have seen that acoustic data allow for new insights on the subject.

It is also important that we employ contextual analyses. The facts that were seen regarding the fronting / backing of standard /u/ and the opening / closure of standard /e,ɛ/ serve as an example, but our data present several others, which were not possible to put under consideration in this paper. Facts such as the following are undoubtedly of interest: (i) throughout the thirteen inquiries it is quite frequent that /o/ has contextual fronting (e.g. Santa Luzia, Mesquita, and Cabeço de Vide, in which /o/ is the least backed of posterior vowels in at least one of the four selected consonantal contexts); (ii) in three of the four inquiries in which /u/ is the backmost vowel (Mesquita, Foros do Arrão, and Freixial) it occurs in at least one consonantal context outside that position, that is, as the second or third backmost vowel.

Appendix

I. Maps[16]

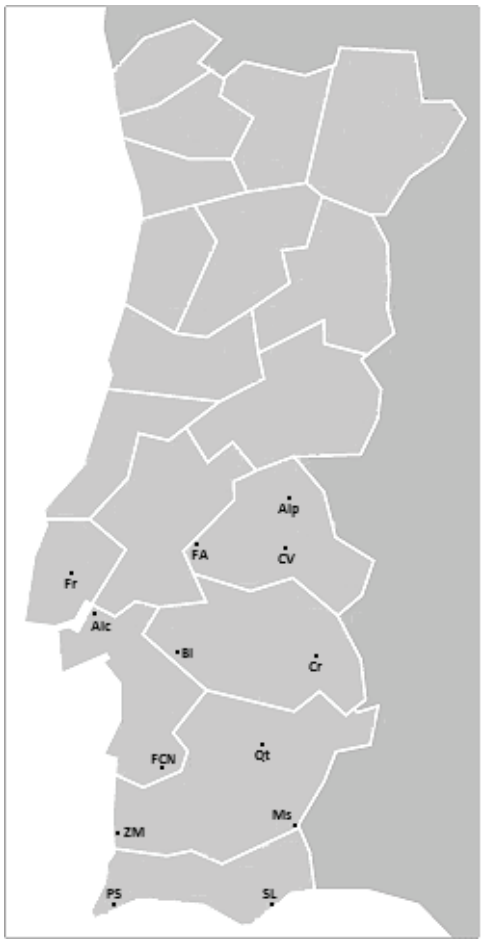


Map 1. «Classification of Galician-Portuguese dialects», by Cintra (1983b:162-163).

We can summarize the above classification in the following way: 1, "dialectos galegos" = Galician dialects; 1.1, "galego ocidental" = western Galician; 1.2, "galego oriental" = eastern Galician. 2, "dialectos portugueses setentrionais" =

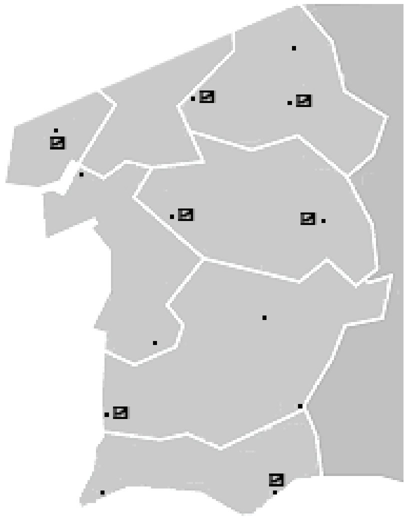
[16] Maps 2 to 6 are adaptations of the general map of inquiry points of the Linguistic and Ethnographic Atlas of Portugal and Galicia presented in the project website (see References).

Portuguese northern, or septentrional, dialects; 2.1, "dialectos transmontanos e alto-minhotos" = Portuguese dialects of the ancient provinces of Trás-os-Montes and Alto Minho (i.e. *the northernmost Portuguese dialects*); 2.2, "dialectos baixo--minhotos-durienses-beirões" = Portuguese dialects of the ancient provinces of Baixo Minho, Douro Litoral, and Beira (i.e. *the southernmost Portuguese northern dialects*). 3, "dialectos portugueses meridionais" = Portuguese southern, or meridional, dialects; 3.1, "dialectos do centro-litoral" = dialects of the central littoral part of the country; 3.2, "dialectos do centro-interior e do sul" = dialects of the central interior and southern parts of the country. 4, "Limite de região subdialectal com características peculiares bem diferenciadas" = literally *limit of a subdialectal area with well differentiated peculiar characteristics*, i.e. a well distinguished subdialectal area. – It must be noted that Cintra's references to the ancient provinces are only approximate; it was not the author's intention to match exactly Galician-Portuguese dialects with provinces (for example, a good part of the province of Beira belongs to the dialects in 3.1, although its name is included only in the name of the dialects in 2.2).

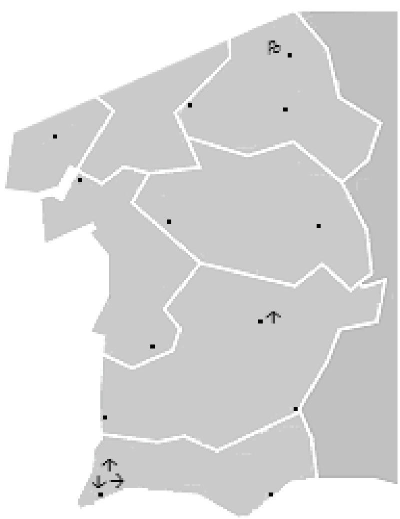


Map 2. Inquiry points.

Alp = (inquiry point of) Alpalhão. **FA** = Foros do Arrão. **CV** = Cabeço de Vide. **Fr** = Freixial. = **Alc** = Alcochete. **FCN** = Foros da Casa Nova. **Bl** = Baldios. **Cr** = Carrapatelo. **Qt** = Quintos. **Ms** = Mesquita. **ZM** = Zambujeira do Mar. **PS** = Praia da Salema. **SL** = Santa Luzia.

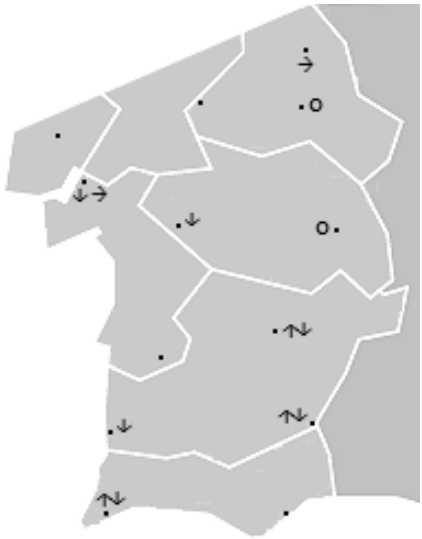


Map 3. Inquiry points with a phonological vowel system identical to standard Portuguese.
☑ = standard Portuguese phonological vowel system.



Map 4. Phenomena concerning standard Portuguese /i/,/a/, /ɔ/ and /o/.

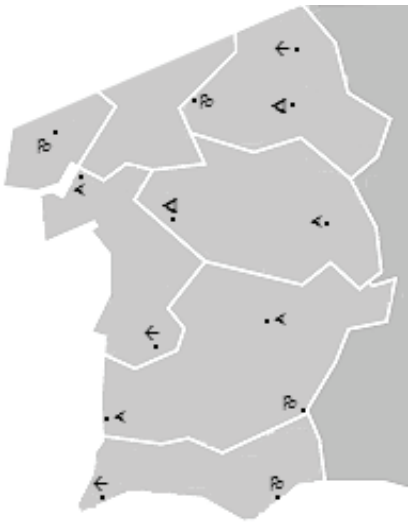
↓ = existence of /i̯/. → = existence of /ɒ/. ↑ = existence of /ɔ̯/. ⚐ = existence of /ɵ/ (i.e. coexistence of /o/ and /ɵ/).



Map 5. Phenomena concerning standard Portuguese /e/ and /ɛ/.

↑↓ = vowel systems that have (i) salient contextual opening / closure of both standard /e,ɛ/ and (ii) the vowel /æ/. ↓ = vowel systems with detached contextual opening / closure of /ɛ/ but without the vowel /æ/.[17] → = *Velarization* of close-mid /e/ that does not come from the ancient diphthong [ej]. o = Lip rounding of both /e,ɛ/.

[17] The same contextual opening / closure of /ɛ/ that can be found in Praia da Salema, Mesquita, Quintos, Zambujeira do Mar, Baldios, and Alcochete is also found in all of the remaining inquiry points, but it does not produce a specific vowel quality (3.3).



Map 6. Phenomena concerning standard Portuguese /u/.

← = existence of /ʉ/. ⱺ = /u/ is the backmost vowel. ≺ = /u/ is less backed than the other two back vowels. ◁ = /u/ is less backed than /o/, but more backed than /ɔ/.

II. Acoustic data

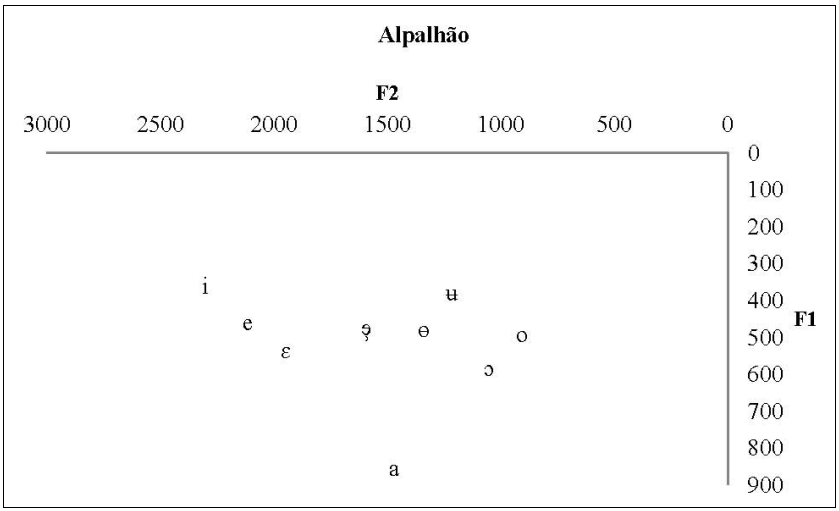
This section is divided into two sub-sections.

Section II-A presents the acoustic data concerning every inquiry point separately. Results are presented in Hertz and are the mean values for each vowel (see more on the subject in Method above). The vowel charts are built from those values. Standard deviations are placed in parentheses below the respective mean values.

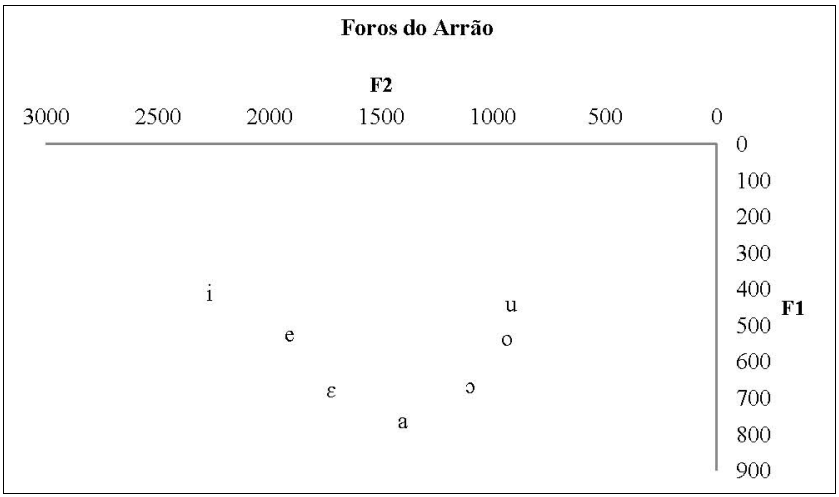
Section II-B presents a synthesis of the vowel charts that are shown in II--A. Inquiry points are grouped according to the position of *u* in the respective vowel system (see more on the importance of the vowel *u* in the area in the Introduction and in 3.2 above).

II-A.

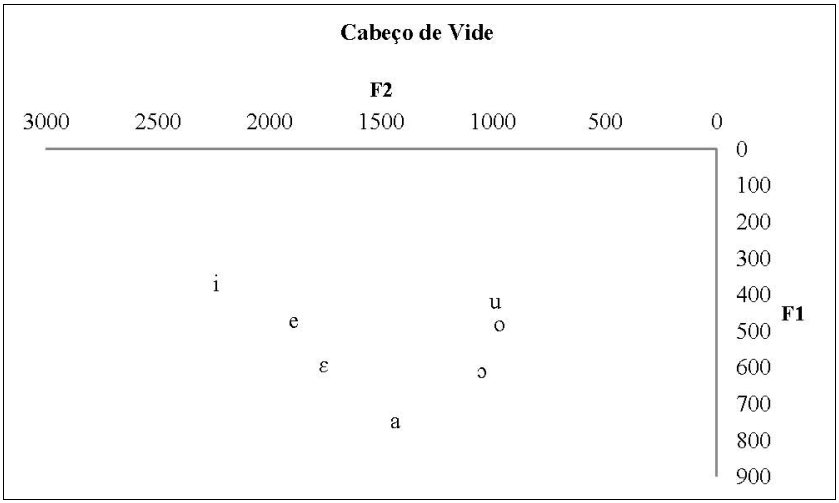
	Alpalhão								
	/i/	/e/	/ɐ̟/	/ɛ/	/a/	/ɔ/	/o/	/ɵ/	/ʉ̟/
F1	360 (8)	458 (17)	471 (12)	533 (9)	853 (31)	581 (24)	489 (11)	476 (20)	378 (8)
F2	2303 (43)	2116 (19)	1592 (107)	1950 (44)	1468 (59)	1053 (70)	906 (14)	1339 (145)	1216 (158)
F3	3142 (85)	2766 (46)	2544 (24)	2608 (81)	2476 (20)	2359 (59)	2456 (46)	2524 (46)	2425 (58)



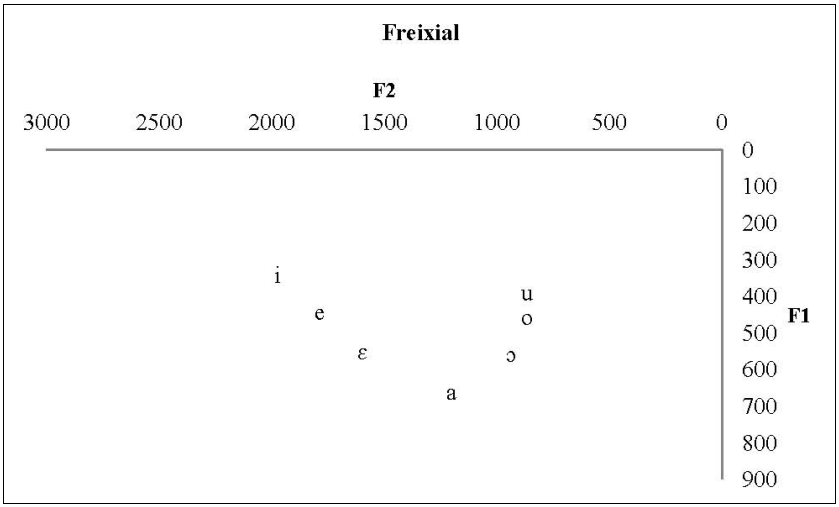
	Foros do Arrão						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	410 (15)	522 (23)	674 (23)	759 (24)	663 (24)	533 (21)	439 (14)
F2	2269 (37)	1909 (104)	1724 (100)	1402 (122)	1101 (115)	938 (96)	919 (99)
F3	2820 (103)	2699 (49)	2644 (90)	2572 (94)	2730 (117)	2732 (36)	2726 (91)



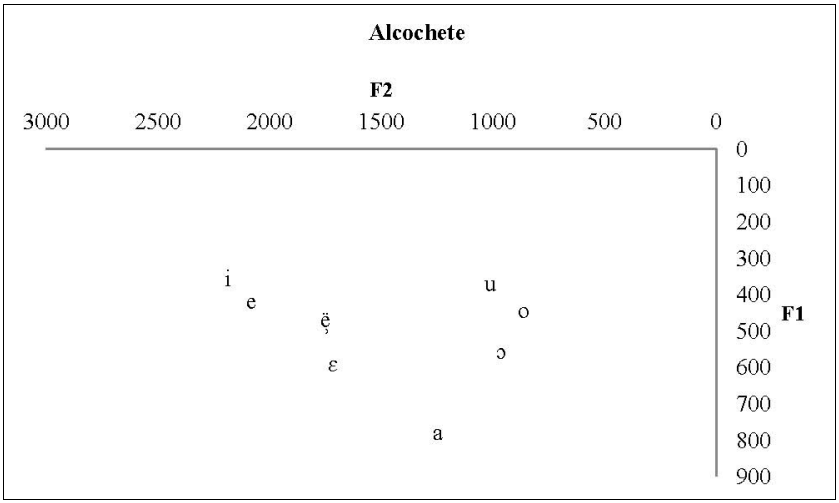
	Cabeço de Vide						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	369 (19)	468 (13)	590 (18)	743 (19)	606 (12)	479 (23)	415 (18)
F2	2241 (64)	1892 (111)	1757 (104)	1435 (114)	1048 (33)	972 (119)	989 (89)
F3	2704 (136)	2364 (77)	2335 (46)	2448 (91)	2518 (42)	2444 (61)	2497 (39)



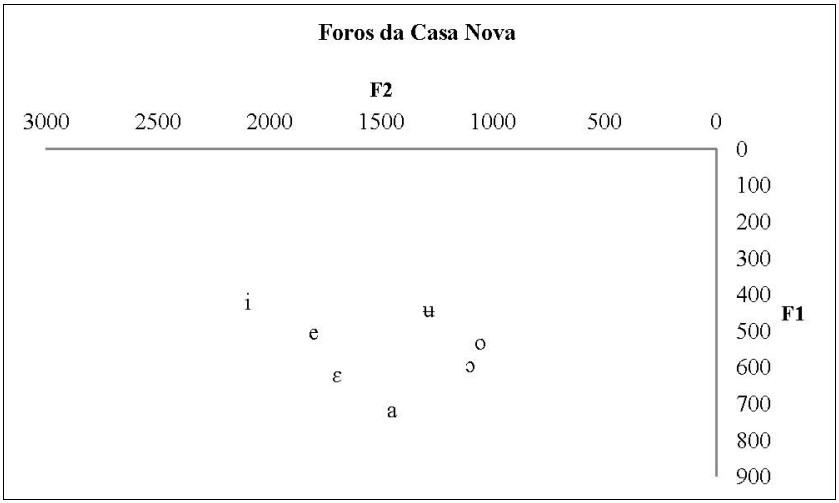
	Freixial						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	340 (17)	442 (2)	548 (5)	660 (14)	557 (12)	454 (3)	389 (13)
F2	1975 (36)	1786 (29)	1599 (30)	1201 (79)	935 (58)	867 (71)	866 (105)
F3	2450 (88)	2257 (25)	2241 (45)	2031 (8)	2079 (74)	2273 (100)	2350 (99)



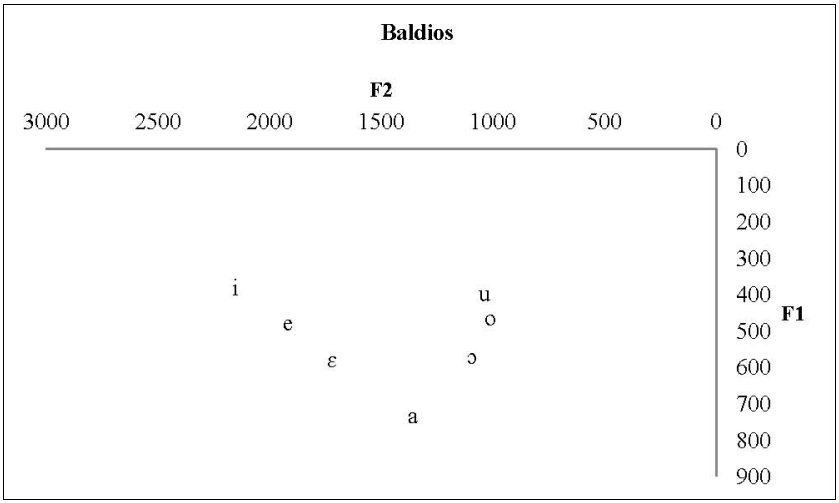
	Alcochete							
	/i/	/e/	/ë̩/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	354 (7)	416 (18)	467 (32)	589 (58)	776 (26)	553 (43)	441 (18)	367 (11)
F2	2189 (36)	2081 (27)	1748 (184)	1719 (98)	1246 (122)	964 (81)	864 (125)	1012 (112)
F3	2626 (49)	2566 (44)	2386 (94)	2322 (99)	2145 (30)	2232 (39)	2296 (46)	2299 (80)



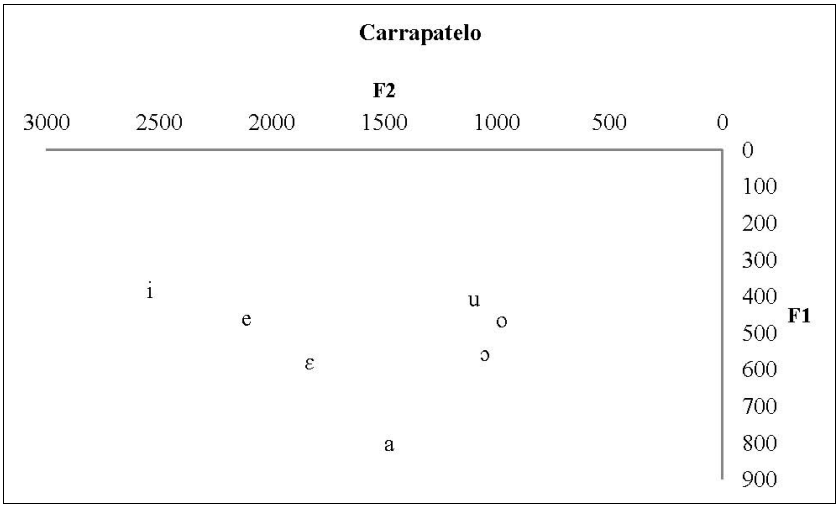
	Foros da Casa Nova						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/ʉ/
F1	418 (20)	500 (27)	618 (11)	714 (26)	590 (24)	528 (39)	439 (30)
F2	2098 (49)	1801 (80)	1697 (80)	1452 (86)	1100 (72)	1057 (82)	1290 (169)
F3	2634 (86)	2415 (69)	2291 (59)	2292 (51)	2286 (25)	2237 (88)	2353 (80)



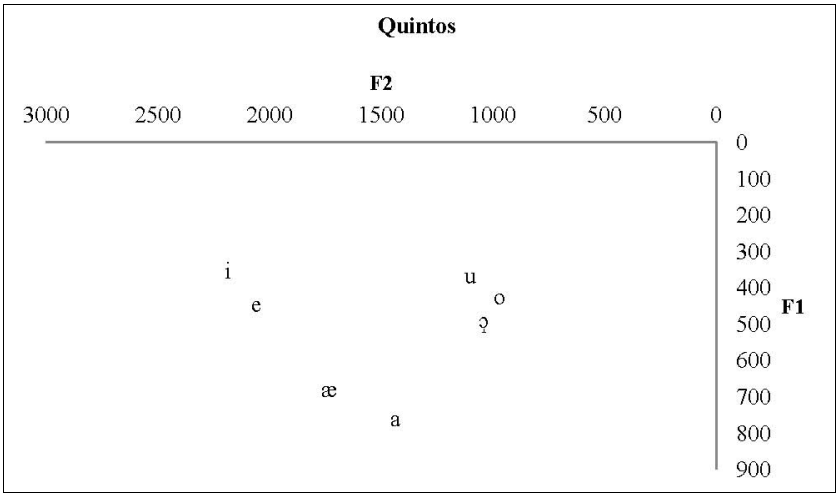
	Baldios						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	379 (13)	476 (18)	576 (17)	731 (23)	568 (8)	461 (11)	395 (11)
F2	2152 (74)	1916 (74)	1721 (99)	1359 (113)	1094 (74)	1013 (84)	1038 (196)
F3	2717 (68)	2530 (29)	2516 (98)	2458 (50)	2401 (102)	2390 (97)	2314 (37)



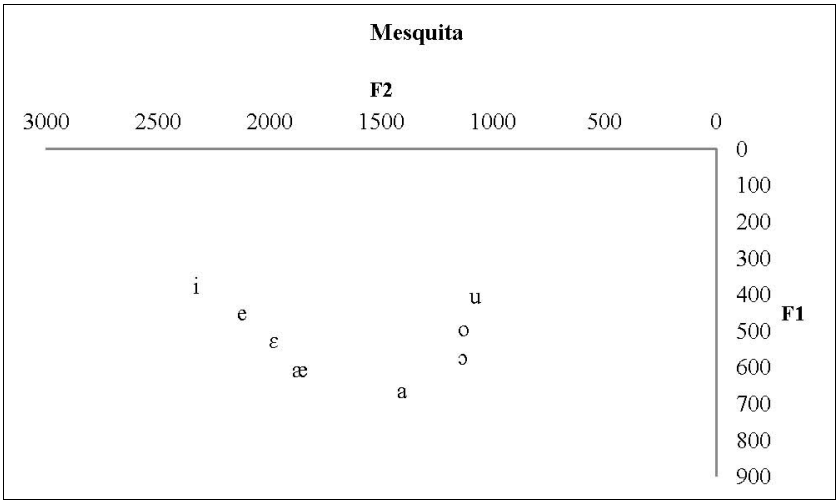
	Carrapatelo						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	381 (12)	457 (5)	576 (22)	798 (16)	554 (7)	463 (10)	405 (13)
F2	2542 (54)	2112 (99)	1834 (31)	1476 (92)	1054 (52)	978 (95)	1101 (84)
F3	2965 (100)	2625 (56)	2628 (37)	2915 (34)	2991 (31)	2883 (31)	2802 (37)



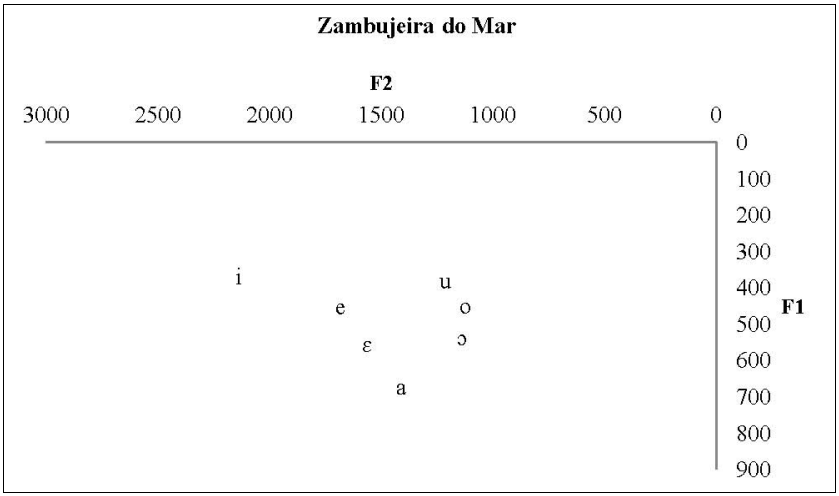
	Quintos						
	/i/	/e/	/æ/	/a/	/ɔ̰/	/o/	/u/
F1	351 (13)	444 (20)	678 (43)	757 (16)	486 (13)	423 (13)	366 (26)
F2	2189 (25)	2058 (46)	1734 (54)	1437 (106)	1040 (116)	971 (154)	1101 (216)
F3	2890 (116)	2669 (68)	2359 (33)	2426 (37)	2421 (61)	2429 (76)	2314 (70)



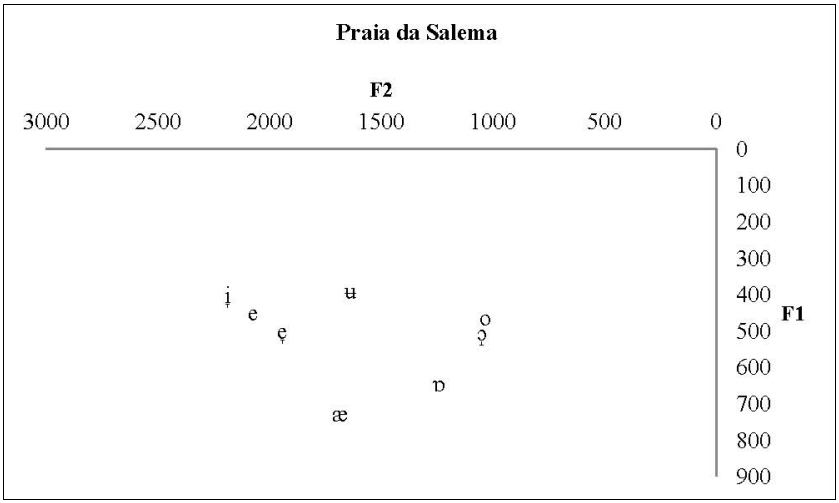
	Mesquita							
	/i/	/e/	/ɛ/	/æ/	/a/	/ɔ/	/o/	/u/
F1	374 (14)	449 (11)	524 (13)	605 (52)	662 (29)	569 (22)	491 (11)	402 (7)
F2	2329 (118)	2121 (60)	1981 (38)	1865 (116)	1406 (94)	1133 (67)	1132 (120)	1079 (140)
F3	2771 (63)	2691 (49)	2714 (23)	2550 (70)	2492 (93)	2572 (77)	2653 (53)	2717 (53)



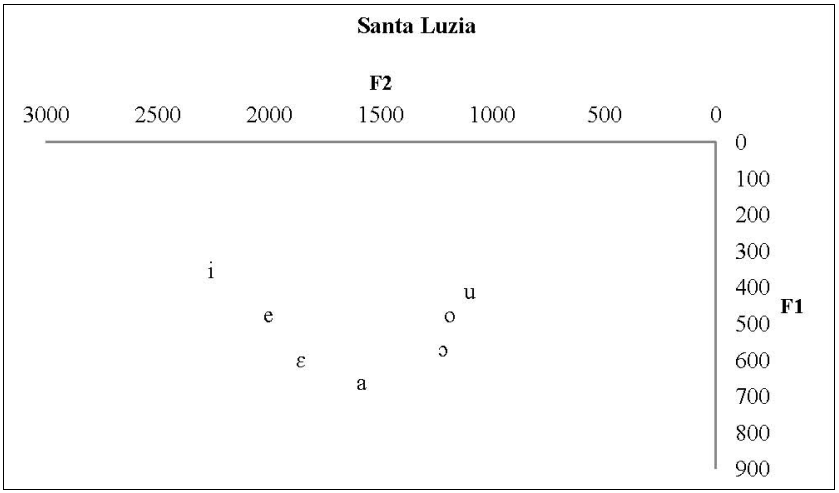
	Zambujeira do Mar						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	368 (7)	451 (19)	553 (29)	671 (36)	535 (9)	448 (12)	379 (10)
F2	2139 (25)	1684 (70)	1566 (20)	1412 (60)	1138 (114)	1125 (109)	1215 (109)
F3	2646 (36)	2492 (61)	2498 (63)	2429 (101)	2345 (104)	2415 (144)	2374 (67)



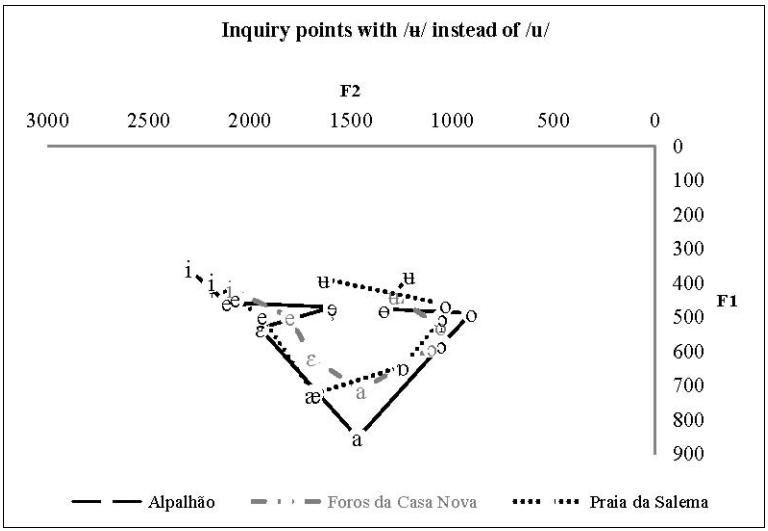
	Praia da Salema							
	/i̪/	/e/	/e̪/	/æ/	/ɒ/	/ɔ̪/	/o/	/ʉ/
F1	399 (10)	447 (14)	498 (29)	726 (41)	643 (37)	503 (21)	463 (25)	388 (16)
F2	2186 (32)	2074 (106)	1942 (81)	1686 (92)	1241 (106)	1049 (101)	1034 (151)	1638 (313)
F3	2811 (31)	2700 (36)	2575 (65)	2742 (46)	2682 (126)	2583 (77)	2497 (55)	2342 (58)

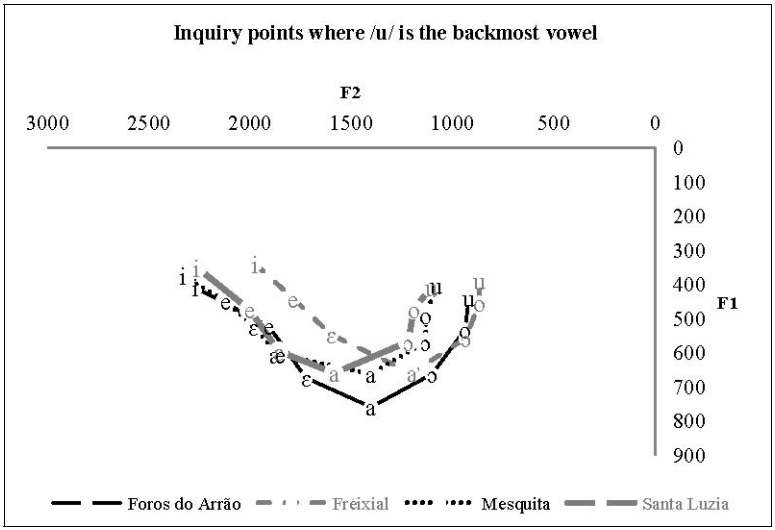


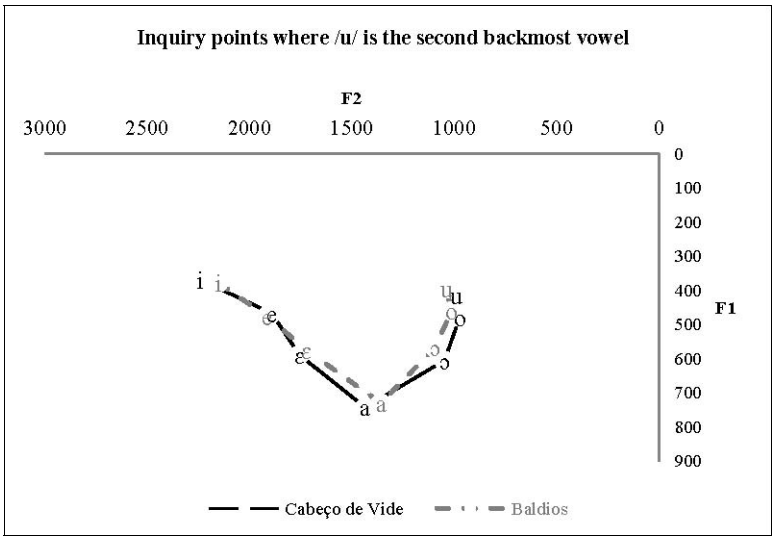
	Santa Luzia						
	/i/	/e/	/ɛ/	/a/	/ɔ/	/o/	/u/
F1	351 (16)	473 (17)	596 (26)	660 (35)	568 (12)	473 (18)	408 (23)
F2	2261 (42)	2004 (23)	1859 (61)	1585 (87)	1219 (129)	1192 (198)	1104 (152)
F3	2925 (69)	2588 (23)	2465 (44)	2309 (30)	2216 (81)	2302 (31)	2356 (61)

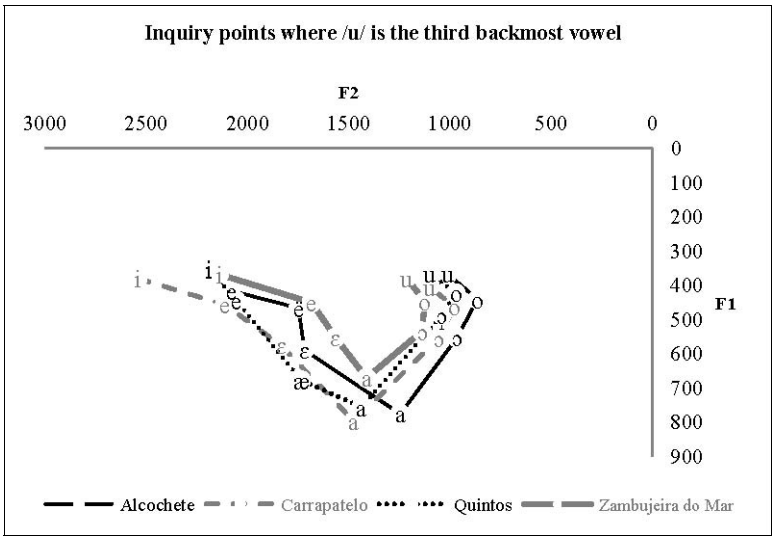


II-B


Inquiry points with /ʉ/ instead of /u/
F2
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
900
F1
Alpalhão
Foros da Casa Nova
Praia da Salema


Inquiry points where /u/ is the backmost vowel
F2
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
900
F1
Foros do Arrão
Freixial
Mesquita
Santa Luzia


Inquiry points where /u/ is the second backmost vowel
F2
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
900
F1
Cabeço de Vide
Baldios


Inquiry points where /u/ is the third backmost vowel
F2
3000
2500
2000
1500
1000
500
0
0
100
200
300
400
500
600
700
800
900
F1
Alcochete
Carrapatelo
Quintos
Zambujeira do Mar

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