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RESEARCH PAPER

Dialectal Variation in European Portuguese Central Vowel Perception

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The present paper aims at providing empirical evidence for dialectal variation concerning the perception of the central vowel [ɐ] in European Portuguese (EP). More concretely, this study compares the perception of the contrast between [a] and [ɐ] by native speakers of two varieties of EP: 23 speakers of a northern Portuguese dialect (from the city of Braga) and 23 speakers of the Littoral Center variety of EP (from the city of Lisbon, defined as Standard European Portuguese (SEP)). Based on a discrimination test, the results show that the two groups of speakers differ with respect to the perception of the contrast between the two central vowels under investigation. The speakers of the northern variety differentiate less between the two central vowels compared to the speakers from Lisbon.

Keywords: European Portuguese; perception; central vowels; dialectal variation

1. Introduction

It has been mentioned in a number of studies that the European Portuguese (EP) dialect spoken in the region of Braga in northern Portugal differs from the EP variety spoken in the Lisbon area with respect to the realization of the central vowels. More precisely, it has been reported in the literature that in stressed syllables, the Littoral/Center dialect shows allophonic variation of [a] and [ɐ], whereas the open vowel [a] is predominant in the north (Barbosa 1965 and 1994; Gonçalves 2008; Martinet 1985).

This observation has been corroborated in acoustic studies focussing on language production which have shown that in the speech of Braga, the vowels [ɐ] and [a] are acoustically and articulatorily equivalents in the tonic syllable (cf. Varanda 2015). As a result, the contrast [a]–[ɐ] is less prominent, or even absent, compared to central and southern Portuguese speech in these contexts. For example, where the Lisbon dialect distinguishes between *tomamos* [tuˈmɐmuʃ] (Engl. 'take', present indicative 1st person plural) and *tomámos* [tuˈmamuʃ] (Engl. 'take', preterite indicative 1st person plural), according to Varanda, Barroso & Rato (2016) the variant [a] generally dominates in stressed and open syllables in the Braga dialect. This means that [a]–[ɐ] is not contrastive in the Braga dialect. In the northern Portuguese variety [ɐ] exists mainly in non-stressed syllables, even though it is not identical to the stressed [ɐ] of the Standard variety due to the process of vowel reduction that generally affects non-stressed vowels in EP (Veloso 2013). Hence, the two dialects do not differ with respect to the realization of [ɐ] in the unstressed syllable but in the stressed syllable.

The present paper takes the findings of Varanda, Barroso & Rato (2016) as a starting point and investigates whether the dialectal difference regarding the production of [a] and [ɐ] is reflected in the speakers' general ability to perceive a contrast between the two vowels. The central research question of this study is the following: Do speakers of the northern variety of Portuguese differ in discriminating between [ɐ] and [a], compared to speakers of the Littoral Center variety, because there are no contexts where the two sounds are contrastive in their dialect?

2. Background and relevance

2.1. The EP vowel system

According to Mateus, Falé & Freitas (2005: 79–80), EP has nine phonetic oral vowels. Depending on the opening of the jaw (open, midopen, midclosed, closed), and the position of the tongue in the oral cavity (front, central, back), they can be distinguished in the following way.

(1) [i] (closed/front), [ɨ] (closed/central), [u] (closed/back), [e] (midclosed/front), [ɐ] (midclosed/central), [o] (midclosed/back), [ɛ] (midopen/front), [ɔ] (midopen/back),
[a] (open/central)

With respect to lip rounding, [o], [ɔ] and [u] are rounded vowels; [a], [ɛ], [e], [ɐ], [i] and [ɨ] are unrounded. The two vowels under consideration in this study, [a] and [ɐ] are both central; they differ with respect to the opening of the jaw: [a] is more open than [ɐ].

Acoustically, the formants F1 (degree of opening or height of the tongue), F2 (position of the tongue) and F3 (roundedness of the lips) are used for the identification of vowels. In the case of [a] and [ɐ], the difference between [a] and [ɐ] will be reflected in different F1 values.

With regard to phonemic status, Mateus, Falé & Freitas (2005: 174) assume that [a] and [ɐ] are allophonic realizations of /a/. More concretely, the assumption is that /a/ is realized as [ɐ] in the Standard variety of Lisbon in stressed open syllables before a nasal consonant (cf. Barbosa 1994: 176). Varanda (2015) follows Mateus, Falé & Freitas' (2005) assumption that [a] and [ɐ] are allophones in SEP, assuming that the nasality of the following consonant can influence the formant F1 (degree of vowel height) of a preceding vowel (cf. Souza & Pacheco 2012: 414). In the Standard Variety, the F1 value of the vowel is lower in this context, leading to a higher and more closed realization (as [ɐ]). Another argument for assuming that [ɐ] is a variant of subjacent /a/ comes from cases of morphophonological alternation (cf. Mateus et al. 2003: 1011). An open vowel [a] in stressed position alternates with a midclosed vowel [ɐ] in unaccented contexts (e.g., *gato* ['gatu] – *gatinho* [gɐ'tiɲu], Engl. 'cat' – 'little cat').[1]

2.2. Dialectal variation in EP vowel production

According to Frota et al. (2015: 236) based on Cintra (1971), Portuguese dialects divide into two main groups: the northern and the central-southern varieties, which are characterized by a number of differential phonetic features. The northern dialects are considered to be more conservative and are characterized by "the absence of the distinction between /v/ and /b/, the presence of /tʃ/, the apical realization of the dental-alveolar fricative (i.e.,

[1] An alternative view has been advocated by Veloso (2012), who argues that [ɐ] occurs in many contexts, where it does not alternate with [a] (e.g., in function words such as a [ɐ] (Engl. 'one'; indefinite article) or in the thematic vowel of nouns such as rosa ['Rɔzɐ], Engl. 'rose'). The author proposes that in addition to /a/, EP also possesses the phoneme /ɐ/. We will not go into further details as our data do not allow us to take a stand concerning the phonemic status of [ɐ] in unaccented syllables because we only tested accented syllables.

[ʂ], [ʐ]), or the preservation of /ow/ (Cintra 1971; Segura & Saramago 2001).” (Frota et al. 2015: 236). The central and southern varieties are considered to be the result of innovations based on territorial expansions from the 13th century onwards (Cintra 1971; Frota et al. 2015).

The northern varieties of EP further divide into the Transmontano and Alto-Minhoto dialect and the Baixo-Minhoto, Duriense and Beirão dialect; the central-southern varieties consist of the Littoral Center dialect and the Interior Center and South variety. **Figure 1**, taken from Frota et al. (2015: 237), gives an overview of the dialectal division of European Portuguese.

Figure 1: Main varieties of EP, based on Cintra (1971) and Segura & Saramago (2001). Map adapted from Frota et al. (2015) with own modifications.

The present study concentrates on the comparison of the variety of EP spoken in the Braga area and the variety of EP spoken in the Lisbon area with respect to the perception of the contrast [a] and [ɐ]. The Lisbon dialect is part of the Littoral Center varieties and considered to be the Standard Variety of EP (SEP). The dialect of Braga belongs to the northern dialects and is part of the Baixo Minhoto variety.

As already mentioned, the Braga dialect has been described in many studies to differ phonologically from SEP with respect to the realization of [a] and [ɐ]. In the Standard dialect, /a/ is realized as [ɐ] in unstressed position or in stressed open syllables before a nasal consonant (cf. Barbosa 1994: 176). For the dialect of Braga, Barbosa (1965) reports that there is no vowel alternation in the context of stressed /a/ in an open syllable followed by a nasal consonant in the north and that [a] is predominant in this dialectal variety. **Table 1** gives an overview of the different realizations of /a/ in different contexts in the two dialects.

Rodrigues & Martins (1999) examine vowel realization in six low-educated speakers of the Braga region. The authors observe that the data from Braga show F1 and F2 values that are different from the ones reported in the literature for the Lisbon variety. Amongst other things, they observe that the informants realize the vowel /a/ in different ways.

Rodrigues, Rato & Silva (2014) compare the realization of vowels in speech corpora from Braga to the results of earlier studies on vowel realization in the Lisbon dialect in Delgado-Martins (2002 [1973]) and Escudero, Boersma, Rauber & Bion (2009). Their investigation also revealed dialectal differences. One interesting observation for the present study concerns the finding that the F1 values in the Braga corpus of Rato (2013) are higher than in the Lisbon dialect speakers in Escudero et al. (2009) and that overall /a/ is realized more openly in the Braga dialect.

Based on these previous findings, Varanda (2015) investigated the acoustic realization of [a] and [ɐ] in tonic open syllables followed by nasal in the speech of inhabitants of the city of Braga. The data was taken from the spontaneous speech corpus *Perfil Sociolinguístico da Fala Bracarense*[2] (PSFB) and analysed phonetically by examining the F1 and F2 values of the vowels in question. This study revealed that in the Braga region, the production of [a] prevails in all studied contexts independent of the education level and the gender of the speakers.

The comparison with studies by Escudero et al. (2009) and Santos (2013), who examined the F1 and F2 values of vowels by speakers from the Lisbon region, corroborates the dialectal differences between the Lisbon and the Braga dialects. Varanda, Barroso & Rato

Table 1: Realizations of [a]–[ɐ] in different contexts in the two dialects.

	[a]–[ɐ]				
	Stressed syllable	**Open syllable**	**Nasal context**	**Realization in Lisbon**	**Realization in Braga**
*g**a**to* 'cat'	+	–	–	[a]	[a]
*g**a**tinho* 'little cat'	–	–	–	[ɐ]	[ɐ]
*nós tom**á**mos* (past) 'we took'	+	+	+	[a]	[a]
nós tom**a**mos (pres.) 'we take'	+	+	+	[ɐ]	[a]

[2] Sociolinguistic Profile of Braga's speech, cf. Barbosa (2009).

(2016) compare the results obtained by Escudero et al. (2009) and Santos (2013) to the PSFB corpus. Based on the examination of the first two formants, they come to the result that in contexts where speakers of the Lisbon variety produce [ɐ] (i.e., in stressed open syllables before nasal consonants), speakers from Braga tend to realize /a/ more openly (lower), showing higher F1 values in these contexts than the speakers from Lisbon.[3]

Varanda, Barroso & Rato (2016) conclude that the phonetic variant [a] predominates in the analysed phonetic contexts in the Braga variety and that this realization of the central vowel /a/ in stressed syllables is indeed characteristic of the Braga variety. This means that, in contrast to the Standard dialect, where both [a] and [ɐ] occur in the stressed syllable in the nasal context, [ɐ] is restricted to unstressed syllables and considerably less salient than [a] in the northern variety.

3. The present study

3.1. Research question and hypothesis

Based on what we know so far about dialectal differences concerning the production of [ɐ] and [a] in the stressed syllable, the present study focuses on the *perception* of the two vowels. The main aim of this study is to investigate whether speakers of the Braga dialect perform differently in discriminating between [ɐ] and [a] in a vowel discrimination task, compared to speakers of the Littoral Center variety of Lisbon.

Our main research question is therefore the following:

- Is there a dialectal difference concerning the perception of [ɐ] and [a] in monosyllabic pseudowords between the speakers of Braga and Lisbon?

Given the results of acoustic studies which have shown that speakers from the Braga region in contrast to speakers from Lisbon differentiate less (or not at all) between [ɐ] and [a] in stressed syllables, we predict that they may also differ with respect to the perception of the contrast [ɐ]–[a]. The tendency towards the absence of [ɐ] in production in the Braga dialect suggests that the sound contrast between [ɐ] and [a] in stressed syllables is less strong in this variety.

This does, however, not mean that speakers living in the city of Braga will generally be unable to distinguish between the two sounds. Given the fact that the Lisbon variety represents the Standard European Portuguese dialect, which is present in the media and in formal settings, we expect that speakers of the Braga variety will not be completely ignorant of the vowel contrast. This means that they may show some perception abilities of the vowel contrast but they will differentiate less between the two vowels and show a higher degree of intra- and inter-individual variation than the speakers from Lisbon.

3.2. Method and participants

This study consists of an online vowel discrimination task, which was conducted with the perception tool *Percy*, developed by the LMU Munich.[4] This tool is specifically designed for perception experiments. As it is not suited for the elicitation of detailed sociobiographical data, *SosciSurvey* was chosen to serve for these matters. Both parts of the test were linked by the insertion of a personalized pseudonym. The whole test with both parts had a duration of approximately 15 minutes.

A total of 46 speakers living in two different regions of Portugal participated in this experiment. Their consent to participate in the study was obtained before they started. According to the sociobiographical questionnaire, 23 participants were born and have

[3] Their study also revealed different F2 values for the two dialects: Braga speakers show lower F2 values than Lisbon speakers indicating that /a/ is produced more towards the front in Lisbon than in Braga.

[4] See http://webapp.phonetik.uni-muenchen.de/WebExperiment/.

always lived in the Lisbon area and 23 participants are from the northern Portuguese area around Braga and have always lived in this region. The participants' age ranges from 18 to 50 years (mean: 25; SD: 8.67), 33 identify themselves as female, 12 as male and one as other. 31 out of 46 participants are university students, the remaining 15 already obtained an academic degree. The majority of the test subjects studied or studies humanities (43), only three have a different academic background. All participants were raised in a monolingual context in Portugal and learned one or more second languages later in life, mostly English. It is important to stress that the northern variety is generally present in all social contexts, i.e., there is no diaglossic distribution of dialectal use and no division into high and low variety in the sense of Ferguson (1959).

The vowel identification task was based on Darcy & Krüger's (2012) oddity vowel categorization task: The participants listened to 60 stimulus sequences in total, each consisting of three monosyllabic CVC pseudo-words and had to determine which of the pseudo-words had a different vowel. For the present study, focused on the oral central vowels, we will analyse the speakers' perception of 28 vowel sequences, which contain the target vowels, either in contrast to each other or, as control condition, in contrast to the vowel [i].[5] In each trial, three items were presented as a stimulus sequence. All tested vowels were embedded in the consonantal contexts /bVʃ/ and /zVʃ/. The plosive and the fricative as the consonants preceding the target vowels were chosen as they were the only possible combinations where the insertion of all four vowels did not lead to an existing European Portuguese word. Because only stressed syllables were tested, the monosyllabic strings are closer to stressed lexical forms than to unstressed clitic forms.

Out of the 28 sequences, 12 were the test items that only contained the vowel contrast between [a] and [ɐ]. Another 12 sequences served as control items and included a contrast between the target vowels and [i] (i.e., [a]–[i] and [ɐ]–[i]). Given that [i] is acoustically and articulatorily very different from both [a] and [ɐ], discrimination should be easy if the participants correctly understood the task. The remaining four sequences were used as distractors as they contained three times the same target vowel, i.e., the participants heard sequences with three identical pseudo-words (catch trials).

The stimuli were produced by three female native speakers of EP from the region of Braga. All of them have phonetic/phonological knowledge and were sensitive to the difference between [a] and [ɐ]. They were recorded in a sound cabin at the University of Minho in Braga, Portugal. The four test item pseudo-words ([baʃ], [bɐʃ], [zaʃ], [zɐʃ]) as well as two control item words ([biʃ], [ziʃ]) were implemented in the carrier sentence "*Eu digo…*" (Engl. 'I say…') and read by the speakers with a normal voice and intonation. The pseudo-words were then extracted and normalized by using *Audacity*.

For each stimulus, the interstimulus interval (ISI) between the three CVC words was determined as 1.5 seconds, following Colantoni, Steele & Escudero's explanation: "It has been argued that an ISI of 500 ms promotes acoustic rather than phonological comparisons between sound, while an ISI of 1.5 seconds or more ensures phonological processing" (2015: 97). The task was to identify the pseudo-word containing a different vowel (see **Figure 2**). Previous to the actual perception task the participants completed a training task consisting of three test items with vowels not used in the actual task in order to adapt to the test scheme. The items in the main task were presented in a randomized order.

A mixed-effect model was applied for statistical analysis, conducted in SPSS version 26. In section 3.3 we will present the descriptive results and the statistical analysis.

[5] The results of the other items will be analysed in a separate study, which includes an experimental group of L2 learners of EP.

Figure 2: Screenshot of the perception test design.

Table 2: Overview of the results.

	Braga (*n* = 23)	**Lisbon (*n* = 23)**
I. Overall correct identification, all 28 items, including distractors	516/644	593/644
% correct overall identification: mean % (SD), including distractors	80.1% (11.7)	92.1% (5.9)
Min./max. value in %	57.1/100%	78.6/100%
IIa. Correct identification, control item contrast [a]–[i]	133/138	138/138
% correct: mean % (SD)	96.4% (10.0)	100% (0.0)
Min./max. value in %	66.7/100%	100/100%
IIb. Correct identification, control item contrast [ɐ]–[i]	129/138	135/138
% correct: mean % (SD)	93.5% (8.3)	97.8% (5.7)
Min./max. value in %	83.3/100%	83.3/100%
III. Correct identification of the contrast [a]–[ɐ]	179/276	246/276
% correct: mean % (SD)	64.9% (22.9)	89.1% (10.5)
Min./max. value in %	8.3/100%	66.7/100%
IV. Correct identification, distractor items (catch trials)	75/92	74/92
% correct: mean % (SD)	81.5% (20.3)	80.4% (28.2)
Min./max. value in %	25/100%	0/100%

3.3. Results and statistical analysis

We will start by presenting the accuracy scores for all 28 test conditions. Subsequently, we will have a closer look on the target vowels [a] and [ɐ] and present the results for those conditions where they are directly contrasted to each other. We will then compare these results to the accuracy rate in contrast to the control item [i]. Finally, the accuracy scores for the distractor items (catch trials) will be shown.

Table 2 shows the results for I. the overall accuracy in all conditions, II. the accuracy rates of the control items (the contrasts [a]–[i] and [ɐ]–[i]), III. the accuracy rates only concerning the target contrast [a]–[ɐ] and IV. the accuracy rates concerning the catch trial items.

The overall accuracy rates in **Table 2** show that the two groups differ with respect to their overall performance. Participants from Lisbon differentiated the vowel contrasts in 92.1% of the cases and participants from Braga in 80.1%. The range of the Lisbon group

lies between 78.6% and 100%, whilst the Braga group scored between 57.1% and 100% of vowel identifications. The same counts for the Standard deviation: it is higher for the participants from the north (11.7) than for the central Portuguese speaker group (5.9).

If we look only at the control item contrasts ([a]–[i] and [ɐ]–[i]), we observe that both groups of speakers show high accuracy scores, indicating that the participants had no difficulties in conducting the task. The Braga speakers obtained 96.4% of correctness for the contrast [a]–[i] and 93.5% for the control item contrast [ɐ]–[i]; the Lisbon speakers reached 100% for [a]–[i] and 97.8% for [ɐ]–[i]. The Standard deviation is low for both speaker groups.

Now let us analyse the test sequences comparing the two target vowels [a] and [ɐ], i.e., the contexts where the target vowels have to be identified against each other. In these contexts, the results show that the identification rate is considerably lower for the Braga group (64.9%) compared to the Lisbon group (89.1%). Here we highlight the range between minimal and maximal scores in both groups. The minimal accuracy score in the Braga group is 8.3%, whereas the maximum score reaches 100%. Accordingly, the Standard Deviation reaches a score of 22.9 in the Braga group. In contrast, for the Lisbon group, the range and the Standard Deviation are between 66.7 and 100%; SD = 10.5. The difference between the two speaker groups is illustrated in the boxplot in **Figure 3**.

Finally, both groups show similar results for the catch trial items (see **Table 2**, IV), which served as distractors. The Braga group scores 81.5% of accuracy (SD: 20.3), the Lisbon group 80.4% (SD: 28.2). Both groups show high variation for these trials, which is typical for catch trial items.

For the statistical analysis, a binary logistic regression model was applied. The dependent variable was *answer value*, meaning whether the given answer was accurate or inaccurate. The factor *given answer* indicates which position was chosen as the one to contain the different vowel (the first, second or third position, or whether all three vowels sounded the same) and therefore takes into consideration whether the speakers have a general tendency for choosing the odd sound of a certain position. *Position of the target vowel* refers to the actual position where the different vowel was placed in the sequencing of the stimuli. The question was whether its position mattered for the accuracy of discrimination. *Target vowel* specifies whether [a] or [ɐ] is asked for, *consonantal context* denotes whether the target vowel is preceded by /b/ or /z/ and *EP variety* contains the information whether the test person answering the item came from the Braga or the Lisbon region.

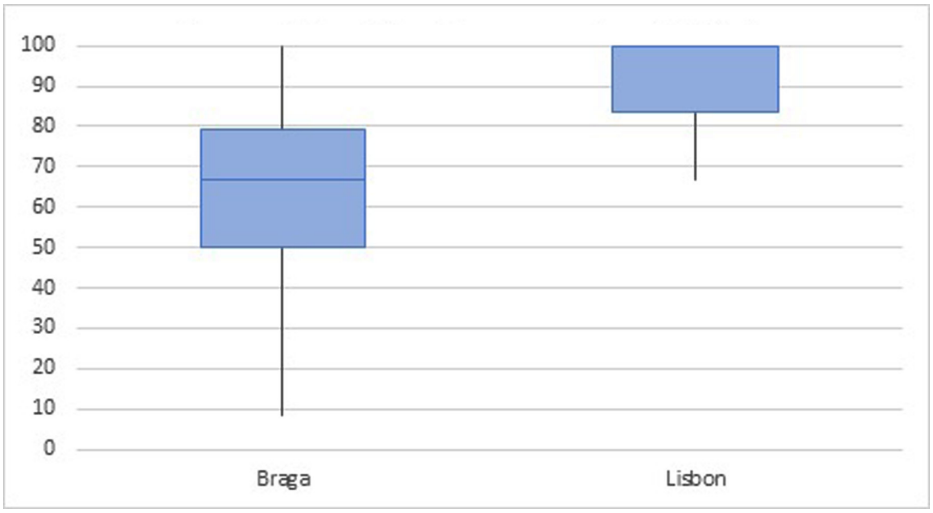

Figure 3: Correct identification rate for the contrast [a]–[ɐ].

Table 3: Cramér's V contingency coefficient for values.

		Value	Approximate Significance
Nominal by Nominal	Phi	1.230	.000
	Cramer's V	.710	.000
N of Valid Cases		736	

Table 4: Results of the most accurate binary logistic regression model.

	B	S.E.	Wald	df	Sig.	Exp(B)
position of the target vowel			6.090	3	.107	
target vowel	.134	.183	.536	1	.464	1.144
consonantal context	.034	.183	.034	1	.855	1.034
European Portuguese variety	–1.106	.192	33.033	1	.000	.331

Because the contingency coefficent in the test for collinearity (Cramér's V) showed that *given answer* and *position of the target vowel* are highly associated (see **Table 3**), *given answer* was excluded from the mixed-effects model.

Hence, we included *position of the target vowel, target vowel, consonantal context* and *EP variety* as fixed effects in the statistical analysis. *Participant* and *item* were entered as random effects. A backward selection of the binary logistic regression models led to the model that had the best overall fit. The winning model consisted of the independent variables *position of the target vowel, target vowel, consonantal context,* and *EP variety*.

Table 4 shows the results of the selected model. There is no effect of the variables *position of the target vowel, target vowel,* and *consonantal context*. The factor *European Portuguese variety* shows a significant negative effect in relation to the reference value, which in this case is Lisbon, encoded as 0. This means that the group from Braga, encoded as 1, is significantly more likely not to differentiate between the two vowels. Hence, the statistical model underscores that the (only) significant factor determining the identification rate of the vowel contrast [a]–[ɐ] is the speaker's belonging to the northern or central EP dialect.

4. Discussion and Conclusion

The main finding of the present study is the corroboration of existing dialectal differences between speakers of the Braga region and speakers of the Lisbon region when it comes to the discrimination between the two vowels [a] and [ɐ]. The speakers of the northern Portuguese variety differ from the speakers of the Littoral Center variety in identifying the vowel contrast under consideration, while all speakers perform similarly in the control conditions. Previous acoustic studies (e.g., Varanda, Barroso & Rato 2016) showed that in the northern variety of Braga, the realization of /a/ as [a] prevails in stressed contexts and that there is no systematic alternation between [a] and [ɐ] as in the Lisbon (Standard EP) variety. The present study adds to this observation by showing that the missing distinction between [a] and [ɐ] is reflected in perception differences. In addition to not producing the difference between both central vowels in open and stressed syllables before a nasal consonant, the speakers of the northern dialect also show a general tendency to not consistently perceive this difference in stressed syllables.

As already discussed in section 2.2, the absence of the vowel contrast [a]–[ɐ] in the northern variety is restricted to stressed syllables, particularly to stressed open syllables

followed by a nasal. The vowel [ɐ] is not totally absent from this dialect, since a similar vowel exists in unstressed syllables (e.g., in *cama* [Engl. 'bed'] ['kamɐ]). However, in EP the unstressed vowel [ɐ] undergoes a process of vowel reduction, so it is not identical to the stressed [ɐ]. This means that the more restricted occurrence of [ɐ] and, mainly, the absence from stressed contexts and, particularly from contexts where it has a discriminating function appears to affect the speakers' overall ability to perceive the difference between [a]–[ɐ]. The trials included in the present experiment are monosyllabic CVC-items; still, the speakers of the Braga dialect show significant lower discrimination abilities than the Lisbon speakers. We therefore conclude that the low ability to perceive the contrast is not restricted to the contexts described in the literature, but also found in monosyllabic stressed contexts followed by a fricative.

It is also noteworthy to mention that the speakers of the Braga dialect show a high degree of intra- and interindividual variation. The ability of the northern dialect speakers to perceive the central vowel(s) is shaped by their exposure to their native dialect where the contrast [a] and [ɐ] is less prominent than in Standard Portuguese speech. However, they are also exposed to some extent to the vowel contrast [a] and [ɐ] when listening to speakers of the central variety (i.e., Standard EP). SEP is of course available to the speakers of the Braga variety as it is ubiquitous for instance in the media. This explains the high variation observed in the group of the northern dialect speakers: some speakers seem more familiar with the Standard dialect than others.

In sum, this study shows that speakers of two different EP varieties perform differently in discriminating the vowel contrast [a]–[ɐ] in a perception task. We presume that the underlying factor might be a difference in the status of [ɐ] in both varieties resulting in a different language acquisition situation. To support our assumptions concerning the status of [ɐ] in European Portuguese, further inquiry needs to be executed to compare the vowel inventories of the northern to the central and southern Portuguese variety. More studies on the contrast [a]–[ɐ] are required, including perception and production tests with different syllable structured test items, including unstressed syllables.

Competing Interests

The authors have no competing interests to declare.

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