

5 Phonological Processes Affecting Vowels: Neutralization, Harmony, and Nasalization

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1. Introduction

In this chapter, we discuss the processes of Vowel Neutralization (VNeu), Mid-Vowel Harmony (MVH), and Vowel Nasalization (VNas). Of these processes, VNeu and VNas are active in the vowel systems of both European (EP) and Brazilian (BP) Portuguese, whereas MVH is only found in BP. We will propose a rule-based analysis of these processes, modeled in the framework of Feature Geometry.

VNeu in Portuguese may affect both unstressed and stressed mid-vowels. Although our focus will be on Unstressed Vowel Neutralization (UVNeu), Stressed Mid-Vowel neutralization will be briefly discussed also. We will analyze unstressed as well as stressed VNeu in both varieties as a mechanism of feature deletion followed by respecification with the unmarked features. Particularly with regard to UVNeu we show that in BP contrastive aperture features are progressively deleted, whereas in EP the set of neutralizable segments are merged in a single operation.

MVH is a variable rule of all regional variants of BP. It applies in the part of the word that precedes the main stress and only affects mid-vowels. In contemporary EP, this process is inoperative.

EP and BP possess a set of contrastive nasal vowels and nasal diphthongs. The ongoing debate among phonologists is whether the oral vs. nasal contrast in vowels and diphthongs is phonological or phonetic. We will follow here the mainstream analysis for BP and EP nasal vowels, which derives these sounds from an underlying /VN/ sequence. For the nasal diphthongs, we will propose a representation in which the nasal feature is associated with the syllable rhyme.

2. Unstressed vowel neutralization

UVNeu is a process that reduces the set of contrastive vowel features under specific prosodic conditions. In BP, UVNeu applies gradiently in the sense that it progressively reduces the

number of height distinctions in the vowel system. In EP, UVNeu results from two different operations, one is neutralization, the other centralization. In this study, we will conceive of neutralization as a process by which contrastive features are removed from the representation of vowel segments in specific prosodic positions.

According to the typology of neutralization processes proposed by Trubetzkoy (1967: 77, 82–87), UVNeu in EP and BP belong to different types. Trubetzkoy distinguishes four types of neutralization, of which the first and third types are relevant for the variants of Portuguese under discussion here.

For the *first* neutralization type, the representative of the neutralizable opposition that appears in the neutralization context does not coincide with either term of the opposition. Instead, it corresponds to:

Trubetzkoy Type 1

- (a) an intermediary sound, phonetically related to both terms of the opposition; or
- (b) a sound which, in addition to the features shared by both segments, has specific features of its own.

The third neutralization type is *internally conditioned*, that is to say, the choice of one of the terms of the opposition as the outcome of the neutralization process only relates to the segments of the neutralized set, without being dependent on contiguous segments. This neutralization type can involve two kinds of phonological oppositions—privative and gradient.

Trubetzkoy Type 3

- (a) In privative oppositions involving a marked and an unmarked term, the marked feature[+F] is neutralized in favour of unmarked [–F];
- (b) in gradient oppositions, as in the aperture contrasts between vowels, the extreme term of the opposition appears in the neutralization context.

From the perspective of Trubetzkoy's typology of neutralization processes, UVNeu in EP is somewhat ambiguous. The neutralized front vowels /i, e, ε/ are represented by a central vowel, the precise phonetic definition of which is a matter of debate among phoneticians (see below). At least superficially, this part of the process could be interpreted as a (1b) type of neutralization. On the other hand, the neutralization of the set of labial vowels /u, o, ɔ/, which is phonetically represented by /u/, belongs to Trubetzkoy's type (3b). As for BP, we will argue that UVNeu involves two steps in a process of progressive neutralization that affects a binary opposition between a marked and an unmarked feature in different contexts, i.e. type (3a) in Trubetzkoy's typology. Furthermore, although the neutralization of front vowels in EP yields a central vowel that is not included in the set of neutralizable vowels, we will argue that UVNeu in EP is best interpreted as the neutralization of the gradient opposition between lower-mid, upper-mid, and high vowels, representing an instance of case (3b) in Trubetzkoy's typology.

2.1. Unstressed vowel neutralization in Brazilian Portuguese

Neutralization of BP unstressed vowels has been explained by different authors¹ pertaining to different theoretical backgrounds by way of three rules, each one applying in a different environment: pretonic neutralization (cf. (1a) below), non-final post-tonic neutralization (cf. (1b)), and word-final neutralization (cf. (1c)).

- (1) a. Pretonic
 'b[ɛ]lo ~ b[e]'leza "handsome" ~ "beauty"
 'k[ɔ]lo ~ k[o]'lar "I glue" ~ "to glue"
- b. Non-final post-tonic:
 'fosf[o]ro ~ 'fosf[u]ro "match"
- c. Word-final:
 'verd[e] ~ 'verd[i] "green"
 'kol[o] ~ 'kol[u] "I glue"

Just as in pretonic syllables, lower mid-vowels do not occur in post-tonic syllables. According to Câmara Jr. (1970), in prefinal post-tonic syllables there is a tendency for dorsal upper-mid vowels to be realized as high vowels (cf. (1b)). In this chapter, we will not be concerned with this phenomenon, since evidence has been advanced suggesting that, in the southern varieties of BP, this process is better described as variable mid-vowel raising, which also involves /e/ (Vieira, 1994).

Consider the words below, which show the productivity of mid-vowel neutralization in pretonic syllables (2a) as well as the neutralization of the contrast between the three series of non-low vowels word-finally (2c).

- (2) a. Neutralization of the contrast between upper- and lower-mid vowels in pretonic syllables
- | | | |
|-------------------------|------------------------------|--|
| 'b[ɛ]la ~ b[e]'leza | "beautiful (fem)" ~ "beauty" | |
| 'm[ɔ]le ~ m[o]'leza | "soft" ~ "softness" | |
| 'm[ɛ]scla ~ m[e]s'clado | "mixture" ~ "mixed" | |
| 'm[ɔ]rte ~ m[o]r'tal | "death" ~ "deadly" | |
| m[ɛ]l ~ m[e]'lado | "honey" ~ "molasses" | |
| s[ɔ]l ~ s[o]'laço | "sun" ~ "great good sun" | |
- b. Exceptions
- | | | |
|--------------------------|-----------------------------|----------------|
| 'b[ɔ]la ~ b[ɔ]'linha | "ball" ~ "little ball" | *b[o]linha |
| 'f[ɔ]rte ~ f[ɔ]r'tíssimo | "strong" ~ "very strong" | *f[or]rtíssimo |
| m[ɛ]l ~ m[ɛ]l'zinho | "honey" ~ "delicious honey" | *m[e]lzinho |
| 'f[ɔ]rte ~ f[ɔ]rte'mente | "strong" ~ "strongly" | *f[or]tment[e] |
- c. Neutralization of non-low vowels word-finally in unstressed open syllables and in syllables closed by /s/.
- | | |
|-----------------------|-------------------------------------------|
| com[e]mos ~ com[i] | "eat-1pl. pr. ind." ~ "eat-3si. pr. ind." |
| abat[e]dor ~ bat[i] | "butcher" ~ "beat-3si. pr. ind." |
| lev[e]zinho ~ lev[i] | "very light" ~ "light" |
| camp[o]nês ~ camp[u] | "countryman" ~ "field" |
| mat[o]rral ~ mat[u] | "dense bush" ~ "bush" |
| pov[o]ar ~ pov[u] | "populate" ~ "people" |
| Londr[e]s ~ Londr[i]s | "London" |

Because of neutralization, BP realizes three different vowel systems in different prosodic contexts through a progressive reduction of the aperture distinctions: /a, ɛ, e, i, u, o, ɔ/—/a, e, i, u, o/—/ a, i, u/. As a consequence of the neutralization of the mid-vowel contrast, the set of seven vowels that occurs in stressed syllables is reduced to a five-vowel system with a single mid-vowel series in unstressed syllables. The further neutralization of the remaining mid-vowel series and the corresponding high vowels creates the basic three-vowel system found in word-final unstressed open syllables.

With regard to pretonic UVNeu, a set of systematic exceptions is found, involving the suffixes, *-(z)inho*, *-mente*, and *-íssimo*, exemplified in (2)b. To explain the exceptional behavior of these words, two different hypotheses have been considered:

- (a) The suffixes *-mente* (adverbial), *-(z)inho* (evaluative), and *-íssimo* (superlative) are prosodic words, so words like *s[ɔ]lzinho* “agreeable sun” *ef[ɔ]rtemente* “stongly” must be interpreted as compounds. This analysis is defended in Leite (1974), Menuzzi (1993), and Schwindt (2013).
- (b) The mentioned suffixes are a special set of suffixes, being attached at a level in the grammar in which pretonic neutralization no longer applies. This proposal is worked out in different ways by different scholars in various versions of lexical phonology. See, for example, Villalva (2000), Mateus and d’Andrade (2000), Bisol (2010). Here we just want to have mentioned this class of systematic exceptions, without taking position with regard to the explanation of their deviant behavior.

The progressive loss of mid-vowels is caused by the neutralization of aperture distinctions in weak prosodic positions. In Table 5.1, we distinguish the four aperture degrees relevant for Portuguese stressed vowels by the multiple use of a binary [\pm open] feature, following Clements (1991).

The first [open] feature divides the aperture space in [+open₁] and [-open₁]. The [-open₁] space is divided into [-open₂] and [+open₂] giving way to a series of mid-vowels, in addition to the low and high vowels. Finally, the [+open₂] space is further divided into [-open₃] and [+open₃], creating a contrast between two series of mid-vowels, one upper-mid, the other lower-mid.

Adopting Wetzels’ (1992, 2011) modelling of obligatory unstressed vowel neutralization in BP, we propose the rule in (3).

- (3) a. Neutralization of the lower- and upper-mid vowel series in BP:

Delete [+open₃] in unstressed syllables

Domain: Phonological Word

Root [+vocoid]

|

Aperture

||

[+open₃] (\rightarrow [-open₃])

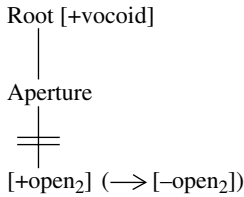
As a first step in the neutralization process of upper- and lower-mid vowels, the marked (positive) [+open₃] feature is dissociated from the aperture node in unstressed nuclei, where it is automatically substituted by the negative (unmarked) [-open₃] feature. The process applies to all unstressed syllables, pretonic as well as post-tonic, as a consequence of which the lower-mid vowels / ϵ , ɔ / only occur under main stress.

Table 5.1 Aperture distinctions in Portuguese stressed syllables.

	<i>i/u</i>	<i>e/o</i>	<i>ɛ/ɔ</i>	<i>a</i>
open ₁	–	–	–	+
open ₂	–	+	+	+
open ₃	–	–	+	+

- (3) b. Neutralization of the mid-vowel and high-vowel series in unstressed word-final syllables which are open or closed by /s/ in BP:

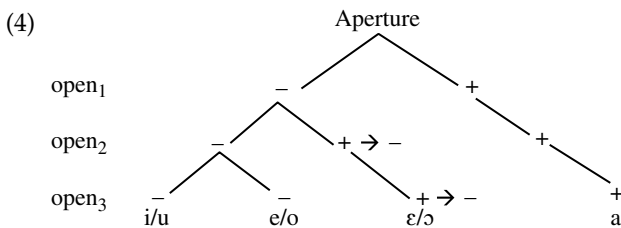
Delete [+open₂]/__(s)##



The rule in (3b) deletes the marked [+open₂] feature from unstressed word-final syllables that are either open or closed by /s/. This rule is obligatory and categorical in most varieties of BP. Nevertheless, due to bilingualism or in areas along the Brazilian border with Spanish-speaking countries, word-final neutralization can be variable or optional: *bol*[o] ~ *bol*[u] “cake,” *val*[e] ~ *val*[i] “valley.”

UVNeu in BP is a prosodically conditioned rule targeting a gradient opposition of aperture degrees which are successively eliminated to create three different vowel subsystems: the most elaborate seven-vowel system appears in the strongest prosodic position, i.e. under main stress; a five vowel system occurs in the prosodically weaker unstressed syllables; the smallest three-vowel system functions in the weakest prosodic position, which is the unstressed word-final open syllable.

The figure (4) below shows the progressive neutralization of the contrastive aperture features through the successive substitution of the marked values of the [± open] feature by the unmarked negative values on the [open₃] and [open₂] tiers:



2.2. Unstressed vowel neutralization in European Portuguese

In EP, UVNeu acts differently upon coronal and labial vowels. While labial vowels merge into /u/, the coronal vowels are represented by a central vowel, different from any vowel that belongs to the neutralized set. Gonçalves Viana (1973 [1892]), Mateus (1982), Mateus and Delgado-Martins (1982) and Delgado-Martins (1996), among others, transcribe the central vowel as [ə], whereas in more recent studies it is transcribed as [ɨ] (Mateus and d’Andrade 2000; Vigário 2001; Veloso 2010).

UVNeu in EP applies to derived and underived words alike. It affects all unstressed vowels, regardless of their position in the word, except word-initially, where [ɨ] is not allowed. The following alternations show the productivity of the raising/centralization process. Examples were taken from Mateus and d’Andrade (2000: 18) and Mateus (1982: 29).

- | | |
|----------------------------------------|--------------------------------------------|
| (5) a. Pre-tonic, underived words | b. Pre-tonic, derived words |
| <i>morar</i> m[u]rar “to live in” | f[ɛ]sta ‘party’ ~ f[i]stinha “small party” |
| <i>murar</i> m[u]rar “to build a wall” | f[o]go “fire” ~ f[u]geira “fireplace” |
| <i>pagar</i> p[ɛ]gar “to pay” | m[ɛ]l “honey” ~ m[i]lado “molasses” |
| <i>pegar</i> p[i]gar “to take” | p[ɔ]rta “door” ~ p[u]rteiro “doorman” |
| c. Non-final post-tonic | d. Final unstressed |
| <i>pérola</i> per[u]la “pearl” | júri jur[i] “jury” |
| <i>báculo</i> bac[u]lo “staff” | jure jur[i] “he/she swears-subj” |
| <i>ágape</i> ag[ɛ]pe “agape” | juro jur[u] “I swear- ind.” |

Some unsystematic exceptions to word-final centralization exist, as exemplified in (5d) by the word *júri* “jury,” providing evidence that neutralization takes precedence over centralization in front vowels. Nonetheless, unstressed word-final [i] is very rare in EP. In the northern dialects it is usually centralized: *júr[i]*, *táx[i]*, etc.

One may interpret the EP variant of UVNeu as a two-step process. As a first step, the contrast between high, upper-mid, and lower-mid vowels is neutralized in favor of the corresponding high vowels. Subsequently, the coronal high vowel, together with the low vowel, are centralized. The differential behavior of the features [coronal], which is lost in the neutralization process, and [labial], which is preserved (Veloso 2013), in addition to the historical evidence showing that neutralization and centralization began to act in different stages of the history of the language (Marquilhas 2003; Mattos and Silva 2008; Paiva 2008, 2009; Maia 2013) suggest that two different rules, neutralization and centralization, are active in EP, as earlier proposed by Veloso (2013).

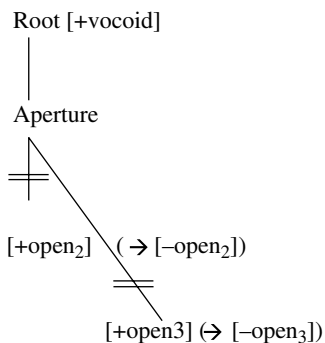
In present-day EP, there is no evidence for a two-step BP-like neutralization process with progressive neutralization of the [±open₃] and [±open₂] aperture contrasts. Unstressed mid-vowels are found mainly as unsystematic exceptions, most of them as a remnant from past stages of the language. In present-day EP, vowel reduction is a single lexical rule of neutralization with a considerable number of exceptions.²

As an instance of Trubetzkoy’s type (3b) neutralization, both upper- and lower-mid vowels are replaced by the corresponding high vowels. This implies the deletion of the relevant aperture features and their subsequent replacement by the unmarked feature values, which, for unstressed vowels, are the negative values.

(6) Neutralization of high, upper-mid, and lower-mid contrasts in EP

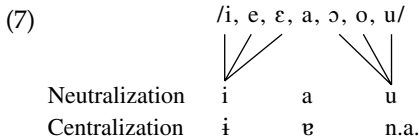
Delete [+open_{3,2}]/unstressed syllables

Domain: Phonological Word



As before, we assume that after the removal of the contrastive features from the relevant tiers, the unmarked negative specifications are automatically provided, i.e. all mid-vowels surface as high vowels.

Instead of treating neutralization for labial vowels and centralization of coronal vowels as two different processes, we opt here for a global process of neutralization creating high vowels, with centralization of the high and the low vowels taken care of by a separate rule. The rule-ordering that we propose is shown in the following derivation:



The precise phonetic definition of the central vowel is a thorny issue. As was observed by Veloso: “central vowels can be characterized as highly variable, unstable, ill-defined vocoids” (2010: 199).

Within the perspective of the above-proposed analysis, one may suggest that the neutralization rule is phonological, while centralization is a rule of allophony, active at the level of the phonological word. The centralization rules concede some exceptions in the standard language, which are not tolerated in non-standard dialects of EP.

2.3. *Mid-vowel neutralization in stressed syllables in EP and BP*

An interesting case of mid-vowel neutralization occurs in stressed syllables in both varieties of Portuguese, as observed in Wetzels (1992). Different from unstressed neutralization, the vowel representing the neutralized mid-vowel contrast in stressed syllables is always lower-mid.³ The process affects words with proparoxytonic stress and words with prefinal stress that end in a heavy syllable. The examples in (8) show the productivity of the process, called Dactylic Lowering by the author, in derived and underived proparoxytonic words.⁴

(8) Dactylic Lowering

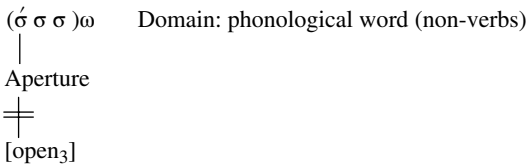
(a) Underived words

m[ɛ̃]dico	“physician”	ab[ɔ̃]bora	“pumpkin”
h[ɛ̃]lice	“propeller”	c[ɔ̃]digo	“code”
c[ɛ̃]rebro	“brain”	l[ɔ̃]bulo	“lobule”
r[ɛ̃]dea	“bridle”	[ɔ̃]sseo	“bony”

(b) Derived words

esquel[ɛ̃]to	“skeleton”	esquel[ɛ̃]tico	“skeletal”
visig[ɔ̃]do	“visigoth”	visig[ɔ̃]tico	“visigothic”
n[o]do'ar	“to stain”	n[ɔ̃]doa	“stain”
ásp[e]ro	“rough”	asp[ɛ̃]rrimo	“very rough”

(9) Dactylic Lowering



In (9) above, neutralization is obtained by the deletion of the contrastive [open₃] feature. However, since Dactylic Lowering applies in stressed syllables and given the preference of stressed syllables for sonorant nuclei, Wetzels (1992) proposes that the unmarked value for the [\pm open₃] feature is the positive value in stressed syllables.

A similar process, called Spondaic Lowering, applies in paroxytonic words with a final heavy syllable. Some examples follow.

(10) Spondaic Lowering

m[ó]vel	“mobile”	C[é]sar	“Caesar”
c[ó]dex	“codex”	indel[é]vel	“unerasable”
d[ó]lar	“dollar”	est[é]ril	“sterile”
m[ó]rmon	“Mormon”	el[é]tron	“electron”
c[ó]smos	“cosmos”	w[é]stern	“western”

Both lowering rules are exceptionless in derived environments and near-exceptionless in underived words. Loan words with the appropriate structure undergo lowering: *d[ó]ping* “doping,” *d[ó]lar*, “dollar,” *W[é]ber* “Weber.” As the names given to the rules suggest, according to Wetzels (1992), these rules are conditioned by their specific rhythmical patterns.

3. Pretonic Mid-Vowel Harmony in BP

Mid-Vowel Harmony (MVH) is a variable phonological process which is part of the history of BP, but completely absent in contemporary EP. MVH can be defined as a process of regressive assimilation of pretonic mid-vowels to a following high vowel within the domain of the phonological word. Its variability is stable, without signs of the process becoming obligatory. MVH has been widely documented with Labovian type sociolinguistic studies in all regions of Brazil, as in Bisol (1981); Callou and Leite (1986); Maia (1986); Viegas (1987), (2001); Barbosa da Silva (1989); Castro (1990); Bortoni, Gomes, and Malvar (1992); Schwindt (1995); Casagrande (2004); Nascimento Silva (2009).

Factors that influence its application concern the distance between trigger and target, the quality of the target and trigger vowels, as well as a number of non-linguistic factors, as one usually encounters for variable rules.

In the previous section it was shown that in the dialects of south and southwest Brazil the sequence of syllables preceding the main stress realizes a five-vowel system. In (11) below, we repeat the way in which aperture distinctions for vowels are represented in the Clements (1991) system of aperture contrasts. The full system in (11) represents the stressed vowel system of BP. In pretonic syllables the aperture feature definitions for the mid-vowels in the

southern dialects are those given for /e, o/, while in the northern and northeastern dialects, the lower mid-vowels /ɛ, ɔ/ prevail in that position.

(11) Aperture distinctions for vowel phonemes

Aperture	i/u	e/o	ɛ/ɔ	a
open ₁	-	-	-	+
open ₂	-	+	+	+
open ₃	-	-	+	+

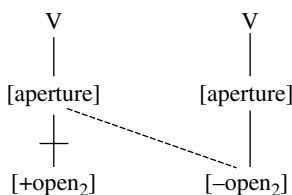
The following words, taken from the studies cited above, illustrate the effect of MVH in nouns and verbs.

(12) Nouns		Verbs	
b[o]nita ~ b[u]nita	"pretty"	b[e]bia ~ b[i]bia	"(s)he drank"
c[o]stura ~ c[u]stura	"sewing"	c[o]rri ~ c[u]rri	"(I) ran"
f[e]liz ~ f[i]liz	"happy"	m[o]via ~ m[u]via	"(I) moved"
m[e]nino ~ m[i]nino	"boy"	m[e]ntirei ~ m[i]ntirei	"(I) will lie"
pr[e]guiça ~ pr[i]guiça	"laziness"	f[e]rido ~ f[i]rido	"hurt"

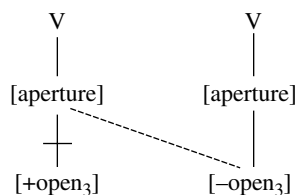
As the examples show, mid-vowels become high before a high vowel in an immediately following syllable. The low vowel /a/ does not trigger low harmony and acts as a blocker: *m[e]lancia* "watermelon" does not become **m[i]lancia*, despite the presence of a stressed high vowel following /a/. Similarly, in the exceptional cases in which unstressed lower-mid vowels appear in the pretonic context (cf. the suffixes in (2b) above), raising does not take place: *b[ɛ]líssimo*, **b[e]líssimo* or **b[i]líssimo*; *b[ɔ]linha*, not **b[o]linha* or **b[u]linha*.

While in the southern dialects lower-mid vowels are absent from the part of the word that precedes the main stress, the northern and northeastern dialects have a preference for lower-mid vowels in this context. However, upper-mid vowels emerge before a syllable with a high nucleus, creating a considerable number of exceptions to the generalization that in these dialects only pretonic lower-mid vowels occur: *f[ɛ]liz ~ f[e]liz* "happy," *al[ɛ]gria ~ al[e]gria* "happiness," *f[ɔ]rtuna-f[o]rtuna* "fortune" (see Barbosa da Silva (1989), Nascimento Silva (2009), and others). As in the southern dialects, mid-vowels are raised one degree on the aperture scale. In this respect the processes are identical, but the result of their application is different: in the variants with pretonic upper-mid vowels total assimilation is obtained whereas assimilation is only partial in dialects with pretonic lower-mid vowels. The processes are exemplified in (13a) and (13b), respectively.

(13) a. Total assimilation



b. Partial assimilation



In the southern dialects, where pretonic mid-vowels are defined as [-open₁, +open₂, -open₃] spreading of the [-open₂] feature of the high vowel creates high vowels out of upper-mid

vowels, while in the northern dialects the spreading of the [-open₃] feature to the lower-mid vowels, defined as [-open₁, +open₂, +open₃], yields upper mid-vowels. The following examples, taken from Nascimento Silva (2009: 193) enable one to compare the outcome of MVH for the two dialect areas:

(14) South	North and northeast	
al[e]gria ~ al[i]gria	al[ɛ]gria ~ al[e]gria	“happiness”
b[e]bida ~ b[i]bida	b[ɛ]bida ~ b[e]bida	“drink”
f[e]liz ~ f[i]liz	f[ɛ]liz ~ f[e]liz	“happy”
f[o]rtuna ~ f[u]rtuna	f[ɔ]rtuna ~ f[o]rtuna	“fortune”
p[o]ssível ~ p[u]ssível	p[ɔ]ssível ~ possível	“possible”
pr[e]sidente ~ pr[i]sidente	pr[ɛ]sidente ~ pr[e]sidente	“president”
pr[o]cissão ~ pr[u]cissão	pr[ɔ]cissão ~ pr[o]cissão	“procession”
n[o]vidade ~ n[u]vidada	n[ɔ]vidade ~ n[o]vidade	“novelty”

In both variants of BP, MVH has the effect of raising the pretonic mid-vowels one degree on the aperture scale. This much has been established beyond doubt. For the northern and northeastern dialects some researchers have claimed that complete assimilation is also possible, as in the word *al[ɛ]gria ~ al[e]gria ~ al[i]gria* (cf. Barbosa da Silva, 1989; Nascimento Silva, 2009).

According to Baković (2007), regressive assimilation can involve contiguous or non-contiguous targets, although usually, contiguity is a necessary condition for this process. In BP, the assimilating feature may spread long distances. Long-distance spreading can be observed in both nouns and verbs, although in the latter category spreading may involve non-contiguous syllables. Examples are provided below.

(15) Long distance MVH

a. Nouns

m[e]r[e]cimento	“merit”	m[e]r[i]cimento ~ m[i]r[i]cimento	*m[i]r[e]c[i]mento
n[e]c[ɛ]ssidade	“need”	n[e]c[i]ssidade ~ n[i]c[i]ssidade	*n[i]c[e]ssidade
p[e]r[e]grino	“pilgrim”	p[e]r[i]grino ~ p[i]r[i]grino	*p[i]r[e]grino
r[e]p[e]tição	“repetition”	r[e]p[i]tição ~ r[i]p[i]tição	*r[i]p[e]tição

b. Verbs

b[e]beria	“drink, 3sg cond.”	b[e]b[e]ria ~ b[e]b[i]ria ~ b[i]b[i]ria ~ b[i]b[e]ria
c[o]rreria	“run, 3sg cond.”	c[o]rr[e]ria ~ c[o]rr[i]ria ~ c[u]rr[i]ria ~ c[u]rr[e]ria
p[o]deria	“be able, 3sg cond.”	p[o]d[e]ria ~ p[o]d[i]ria ~ p[u]d[i]ria ~ p[u]d[e]ria
s[o]freria	“suffer, 3sg cond.”	s[o]fr[e]ria ~ s[o]fr[i]ria ~ s[u]fr[i]ria ~ s[u]fr[e]ria

Whereas spreading in nouns always affects contiguous syllables, in verbs syllables can be skipped apparently. This is particularly visible in the class of /e/-conjugation verbs, when more than one mid-vowel precedes an /i/-initial suffix. Besides the cases of continuous harmony, one often finds a corresponding form in which the theme-vowel remains unaffected by MVH, as in the right column of the verbs in (15b). However, also in verb forms of other conjugations we observe the presence of high vowels, as in *c[o]nseguir* “succeed” ~ *c[u]nseguir* “I succeed,” where /e/ is part of the root. At the same time, the sequence *c[u]nseguir* “I succeed” is found as the 1st. present indicative form of the same verb, which could be interpreted as the regular outcome of MVH. One might consequently think that, to explain the high vowel in the

first syllable of the infinitive *c[u]nseguir* “succeed,” some paradigmatic force is at work. However, reality is more complex, as is shown by the verb forms *g[o]verno* ~ *g[u]verno* “I govern” or *g[o]vernaria* ~ *g[u]vernaria* “I would govern.” Notice that the alternation in the latter form cannot be explained by the high vowel of the suffix, since we have seen above that /a/ is a blocker. Matters clear up if we consider alternations between mid-vowels and high vowels in nouns: *b[o]neca* ~ *b[u]neca* “doll,” *t[o]mate* ~ *t[u]mate* “tomato,” *g[o]verno* ~ *g[u]verno* “government,” where there is no trigger for MVH. As it appears, MVH co-exists with a variable process of mid-vowel raising (MVR) in pretonic syllables.⁵ We may consequently explain the cases of apparent non-contiguous MVH in verbs as prosodically conditioned raising, similar to what happens in post-tonic and, particularly, in unstressed word-final open syllables in BP, where mid-vowels are realized as high vowels.

(16)		MVR		MVH	
	<i>c[o]mer</i>	~ <i>c[u]mer</i>	“eat”	<i>c[u]m[e]ria</i>	~ <i>c[u]m[i]ria</i> “I would eat”
	<i>c[o]rrer</i>	~ <i>c[u]rrer</i>	“run”	<i>c[u]rr[e]ria</i>	~ <i>c[u]rr[i]ria</i> “I would run”
	<i>p[o]der</i>	~ <i>p[u]der</i>	“be able”	<i>p[u]d[e]ria</i>	~ <i>p[u]d[i]ria</i> “I would be able”
	<i>g[o]verno</i>	~ <i>g[u]verno</i>	“govern”	<i>g[u]v[e]rnia</i>	~ <i>g[o]v[e]rnia</i> “I would govern”

As for the verb forms categorized as resulting from MVH in the right-hand column of (16), it would be possible in principle to consider them as the result of long-distance MVH or as the conjoint effect of local MVH and mid-vowel raising.

Another interesting aspect of MVH concerns the different triggering potential of the two high vowels /i, u/. It was repeatedly observed in studies dealing with MVH that /i/ more frequently triggers assimilation than /u/. In particular, unlike /u/, /i/ has the same raising effect on either one of the mid-vowels, whether it be /e, ε/ or /o, ɔ/. On the other hand, the labial high vowel has a greater effect on /o, ɔ/ than on /e, ε/.

Comparing the height of the two high vowels within the phonetic space of the BP vowel system, one observes that /i/ is the highest vowel, with /u/ being considerably lower, only slightly higher than /e/. Consequently, the high labial vowel has a weaker raising potential with regard to /e/, which, in order to be raised to /i/, becomes phonetically higher than the trigger vowel /u/ itself. This may account for the preservation of the mid-vowel in such words as *l[e]gume* “vegetable,” *p[e]rgunta* “question,” *p[er]fume* “perfume,” in which MVH is unattested (see Bisol, 1981).

A final remark concerns the prosodic strength of the trigger vowel. The triggers for MVH can be both stressed and unstressed vowels, as in *f[e]liz* ~ *f[i]liz* “happy” with stressed word-final /i/, as compared with *pr[o]cissão* ~ *pr[u]cissão* “procession,” with stress on the nasal diphthong, although harmony more frequently happens when the trigger vowel is stressed.

4. Nasal vowels and nasal diphthongs

4.1. Nasal vowels

In both variants of Portuguese, the contrast between upper- and lower-mid vowels is neutralized for nasal vowels in favor of the upper-mid quality. At the phonetic surface, oral and nasal vowels are contrastive, as illustrated with the words in (17):

(17)	<i>s[ê]da</i>	“path”	<i>seda</i>	“silk”
	<i>l[ī]do</i>	“beautiful”	<i>lido</i>	“read”
	<i>t[ū]ba</i>	“tomb”	<i>tuba</i>	“tuba”
	<i>l[ô]bo</i>	“loin”	<i>lobo</i>	“wolf”

Surface contrastive nasal vowels have at least three different phonetic realizations: [ˈvẽndɐ], [ˈvẽjdɐ], [vẽdɐ] for *venda* “sale.” Whereas in BP all three pronunciations occur, in EP the third possibility is the most frequent, as argued by Mateus and d’Andrade (2000). When a consonant is present phonetically, its place features are identical with those of the following stop. Before a fricative onset or word-finally, the consonantal element may share its place features with the preceding vowel or surface as a falling diphthong: *bem* [bẽj/ɲ] “well” or *bom* [bõw̃/ŋ] “good.”

Since the time of structural linguistics, two views about Portuguese nasal vowels are competing. Whereas one group of scholars maintains that nasality is contrastive in vowels (/ĩ/ vs. /V/), as, for example, defended in Hall (1943a,b), the other group argues in favor of a biphonemic representation consisting of an oral vowel followed by a tautosyllabic nasal consonant /VN/, as in Nobeling (1903) and many others after this author’s early publication. Clearly, the controversy originates from the fact that the nasal vowel often surfaces without or with only a short nasal constriction in BP, while in EP the consonantal constriction usually does not appear.

The biphonemic interpretation of the nasal vowel becomes prevailing with Câmara Jr. (1953, 1970) in Brazil and with Barbosa (1965) in Portugal. Câmara Jr. (1970) includes his analysis of nasal vowels in the chapter on syllabification, arguing that nasal vowels are phonologically closed syllables.

Here we adopt the biphonemic way of representing nasal vowels, for which we summarize the evidence as given in Câmara Jr. (1953, 1970), Barbosa (1965), and Mateus and d’Andrade (2000).

- In Portuguese, weak /R/ and strong /R/ contrast intervocalically, as in *caro* “expensive” and *carro* “car,” respectively. Elsewhere, these sounds are in complementary distribution, with strong /R/ systematically following the nasal vowel: *hon*/R/*a* “honor,” *ten*/R/*o* “tender,” *gen*/R/*o* “son-in-law.” Since strong /R/ is also obligatory syllable-initially after a consonantal coda: *is*/R/*ael* “Israel,” *guel*/R/*a* “gill,” etc., the biphonemic representation readily explains the ban on weak /R/ following a phonological /VN/ sequence.
- Branching rhymes make heavy syllables. Nasal vowels show solidarity with branching rhymes as regards generalizations that refer to syllable weight. For example, words with antepenultimate stress are relatively frequent in Portuguese. However, the proparoxytonic stress pattern is only allowed in words with a prefinal light syllable. Typically, words with prefinal nasal vowels never show proparoxytonic stress: *rápido* “fast,” **rápindo*, **rápildo*, **rápirdo*, etc.
- In morphological derivations before vowel-initial suffixes, the underlying /VN/ sequence often surfaces as an oral vowel followed by a nasal consonant: *afeg*[ẽ] “Afghan (fem.)” ~ *Afeg*[ẽn]*istão* “Afghanistan,” *r*[ẽ] “frog” ~ *r*[ẽn]*ário* “frog farm,” *pat*[ĩ] “skate” ~ *pat*[in]*agem* “skating,” etc. The same is true for productive prefixes like *-in*, which surface with a nasal vowel when prefixed to a consonant-initial root, as in [ĩ] *possível* “impossible,” but with an oral vowel when the nasal consonant is syllabified as the onset of the root: [in]*útil*, “useless.”

The view of nasal vowels representing underlying /VN/ sequences was tested in a perception test done by Moraes (2013: 109–110), who describes the experiment as below.

In a word like *mando* [ˈmẽ̃ːdu], the sound [d] was electronically erased. Depending on the perceptual prominence of the nasal appendix [n], the resulting word should be perceived as either *mão* [mẽ̃w̃] or *mano* [mẽ̃nu]. The first alternative would support the hypothesis of a mere transition, not phonological, of this consonantal segment (homosyllabic interpretation).

The second alternative ([n] perceived as heterosyllabic) means that the original appendix in the syllable coda resyllabifies and becomes a full consonant in the syllable onset, in which case the biphonemic hypothesis would be preferred.

As it turned out, the second alternative—*mano*—was chosen by most participants, confirming the phonological status of the nasal consonant as part of the underlying /VN/ sequence.

4.2. Nasal diphthongs

Besides the phonetic nasal diphthongs derived from underlying /VN/, Portuguese also has lexical nasal diphthongs. In lexical nasal diphthongs, the nuclear vowel is either /a/ or /o/.⁶ The following words show a nasal diphthong in the singular and the corresponding plural. The phonetic transcription reflects the BP pronunciation.

(18) Singular			Plural	
a. <i>irmão</i>	[ixmẽw̃]	“brother”	<i>irmãos</i>	[ixmẽw̃s]
<i>mão</i>	[mẽw̃]	“hand”	<i>mãos</i>	[mẽw̃s]
<i>cidadão</i>	[sidadẽw̃]	“citizen”	<i>cidadãos</i>	[sidadẽw̃s]
b. <i>cão</i>	[kẽw̃]	“dog”	<i>cães</i>	[kẽj̃s]
<i>capitão</i>	[kapitẽw̃]	“captain”	<i>capitães</i>	[kapitẽj̃s]
<i>pão</i>	[pẽw̃]	“bread”	<i>pães</i>	[pẽj̃s]
c. <i>verão</i>	[verẽw̃]	“summer”	<i>verões</i>	[verõj̃s]
<i>limão</i>	[limẽw̃]	“lemon”	<i>limões</i>	[limõj̃s]
<i>feijão</i>	[fejẽw̃]	“bean”	<i>feijões</i>	[fejõj̃s]

The apparent irregularity of the plural forms, [ãj̃s], [õj̃s] corresponding with the singular [ẽw̃] has been much debated in the literature. To account for these alternations in the synchronic grammar of Portuguese, Câmara Jr. (1970: 85) explains the different plural forms as the consequence of different underlying nominal class markers, as shown with the plural examples in (19b).

(19) a. Singular			b. Plural	
[irmẽw̃]	/irmaN-o/	“brother”	[irmẽw̃s]	/irmaN+o+S/
[kapitẽw̃]	/kapitaN-e/	“captain”	[kẽpitẽj̃s]	/kapitaN+e+S/
[verẽw̃]	/veroN-e/	“summer”	[verõj̃s]	/veroN+e+S/

Similar proposals can be found in Morales-Front and Holt (1997), Mateus and d’Andrade (2000), Veloso (2005), Bisol (2013) and others. In Wetzels (1997) it is argued that words ending in nasal diphthongs are athematic and lexically represented with a nasal glide.⁷

The words in (18a), which preserve [ãw̃] in the plural form, are very limited in number. Some examples are: *irmãos* “brothers,” *pagãos* “pagans,” *grãos* “grains,” *mãos* “hands,” *órfãos* “orphans,” *órgãos* “organs.” Even less frequent is the class in (b) in which the vowel /a/ is present in both the singular and plural forms: *capitães* “captains,” *pães* “loaves (of bread),” and *cães* “dogs.” By far the most frequent are the words in (c), which

show a [ẽw̃] ~ [õj] alternation. As it appears, Portuguese nominal roots surfacing with a nasal diphthong either end in /aN/ or in /oN/ lexically. The class of root-final /oN/ nouns are the most numerous class.

We have just seen that Câmara Jr. (1970: 85) proposes for the word *irmão* “brother” the representation /aN+o/, i.e. as being thematic. In a different study he establishes a parallel between, on the one hand, the representation of oral and nasal vowels as a contrast between /V/ vs. /VN/ and, on the other hand, the nasal diphthong as an oral diphthong followed by /N/ (1971: 33). Here we will adopt the view that word-final nasal diphthongs are derived from underlying /VN+V/, where /+V/ is a class marker. A morphologically conditioned rule deletes the nasal consonant, while its nasal feature remains in the representation /V[nasal]+V/. Since we assume that words surfacing with a nasal diphthong derive from thematic words, in accordance with Câmara Jr (1970), Mateus and d’Andrade (2000), and Bisol (2013), the theme vowel must be changed into a glide, which assimilates the coronal features of the plural morpheme /S/: /V^[nasal]jS/. Finally, to account for the fact that phonological sequences of the type /veroN+o/ surface with word-final [ẽw̃], we must posit a lexical rule which neutralizes the contrast between [ẽw̃] and [õw̃], probably by dissimilation. Obviously, the few words in which the labial glide does not become coronal must be marked as exceptional to the lexical rule that turns /u/ to /i/ before /S/.

5. Conclusion

EP and BP both have a neutralization rule which reduces the seven-vowel system that exists in stressed syllables to the three-vowel system /i, u, a/ in atonic syllables. This basic system is attested in all positions in EP, but only word-finally in BP. The distinction that must be made in BP between unstressed vowel neutralization and word-final unstressed vowel neutralization has motivated our decision to derive the neutralization facts in this variety of Portuguese as a two-step process. No such evidence exists in EP, for which the global reduction of the seven-vowel system to the three-vowel system is derived as a single process. By separating neutralization and centralization in EP, we were able to show that the neutralization rules in BP and EP are very similar and only different in scope. As regards the rules of stressed mid-vowel neutralization, both rules are productive in EP and PB.

In BP, neutralization is not the only rule that is active in pretonic syllables. Within the five-vowel system created by UVNeu, two variable processes are simultaneously eliminating the mid-vowels in the southern dialects. One is a rule of regressive MVH triggered by the high vowels /i, u/, in which /i/ is more forceful as a trigger than /u/. The other one is a prosodically conditioned rule which raises /e, o/ to /i, u/. The combined effect of these rules suggests a future for these dialects in which the basic three-vowel system /i, a, u/ extends to all unstressed syllables, generalizing the pattern that already exists in word-final unstressed open syllables. In the dialects of the north(east), which show a preference for lower-mid vowels in pretonic syllables, VH raises /ɛ, ɔ/ to /e, o/, recreating a seven-vowel system as it exists under stress.

The phonological analysis of nasal vowels and nasal diphthongs is without doubt the part of the Portuguese vocalism where scholars disagree the most. Here we have presented the traditional view of the lexical presentation of these sounds, conscious of the fact that the discussion will surely continue.

NOTES

- 1 See, among others, Câmara Jr. 1970, Lopez 1979, Wetzels 1992, Lee 1995.
- 2 Vigário (2001) identifies the most relevant of such exceptions.
- 3 Unless neutralization is the result of assimilation, in which case the resulting vowel may be either upper or lower mid.
- 4 The examples in (9–10) are taken from Wetzels 2011.
- 5 Vowel raising is not observed for all nouns, as those given in (15a). For vowel raising in words without a high vowel, see Klunck 2007, Cruz 2010, Correa da Silva 2014.
- 6 Nasal diphthongs are almost always word-final and almost exceptionally attract word-stress. A few exceptions exist: (1) Few words have a word-internal nasal diphthong, such as in *cãimbra* “cramp” or *zãimbro* “one-eyed”; (2) in a small set of words stress is prefinal, as in *órfão* “orphan,” *órgão* “organ,” and *bênção* “blessing.”
- 7 See also Chapter 6 on the syllable and Chapter 11 on the morphology and phonology of inflection.

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