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## VOWEL REDUCTION AND EMPTY NUCLEI IN EUROPEAN PORTUGUESE: AN ANALYSIS OF THE SYLLABLE STRUCTURE<sup>1</sup>

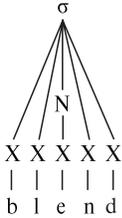
### **Abstract**

The purpose of this article is to outline Portuguese syllable structure. The shape of the syllable in European Portuguese (the standard southern and central dialect) is suggested to be identical in slow and fast speech (Mateus – d’Andrade 2002). This view is challenged in this article by an analysis of Vowel Deletion and Vowel Nasalisation. It is argued that within the skeletal theory of the syllable, it is impossible to maintain the same syllabic structure for slow speech and fast speech.

### **1. Introduction**

The founding assumptions of skeletal theory<sup>2</sup> go back to Steriade (1982), Clements – Keyser (1983), Levin (1985), Lowenstamm – Kaye (1985), and others. It is also discussed in Dresher (1985), Itô (1986), Nespor – Vogel (1986), Hayes (1989), and McCarthy – Prince (1995). The main principle is that each segment at the melodic tier possesses a corresponding *timing slot* (called X-slot) at the skeletal tier. Thus, for instance, the English word *blend* has five segments at the melodic tier and five X-slots which constitute one syllable ( $\sigma$ ). This is shown in (1). I omit the Rhyme node, as it is irrelevant for the purposes of this article.

(1) Syllable structure of the word *blend*



The X-slot convention differs from the traditional CV approach (Clements – Keyser 1983) in that all segments are assigned abstract X-slots, and there is no distinction between vowels and consonants at the skeletal tier. In (1), the vowel *e* is the nucleus of the syllable (N), while the sounds *bl-* and *-nd* constitute an onset and a coda, respectively.

The skeletal framework does not necessarily assume a one-to-one correspondence between the melodic and the skeletal tiers. There are instances of words with one segment at the melodic tier which possesses no corresponding X-slots, for example, Slavic yers (see Rubach 1986). Conversely, an X-slot may have no correspondents at the melodic tier (see for example Goldsmith (1990) for a discussion of French h-aspiré). Such an X-slot is called a *floating X-slot*. A floating X-slot may serve as an *empty onset* or as an *empty nucleus*. The notion of empty nuclei is discussed in more detail in the following section.

## 2. Syllable structure

As was established by Mateus – d’Andrade (2002), Portuguese syllables exhibit rigid limitations regarding the possible shape of each syllable constituent. To begin with, the only well-formed nuclei consist of a vowel or a diphthong, and this is true for both slow and fast speech. There are no syllabic consonants in either speech tempo.

Secondly, the only segments licensed in the coda are the alveolar liquids [l r] and the voiceless palatal fricative [ç].<sup>3</sup> While this assumption is uncontroversial for slow pronunciation, the status of the Portuguese coda in fast speech raises many doubts due to the highly productive process of unstressed vowel deletion.

In slow pronunciation, unstressed [ɛ e] are raised to the high back vowel [ɨ]<sup>4</sup>, whereas [ɔ o] are raised to [u]. The relevant examples can be found in (2).

(2) Vowel reduction in slow speech<sup>5</sup>

- (a)  $\text{ɔ} \sim \text{u}$   
 forço [f'ɔrs+u] 'I oblige' vs. forçar [fur's+a+r] 'to oblige'<sup>6</sup>
- (b)  $\text{o} \sim \text{u}$   
 força+a [f'ɔrs+ɐ] 'strength' vs. forçar [fur's+a+r] 'to oblige'
- (c)  $\text{ɛ} \sim \text{i}$   
 sel+o [s'ɛl+u] 'I stamp' vs. selar [si'l+a+r] 'to stamp'
- (d)  $\text{e} \sim \text{i}$   
 selo [s'ɛl+u] 'stamp' vs. selar [si'l+a+r] 'to stamp'

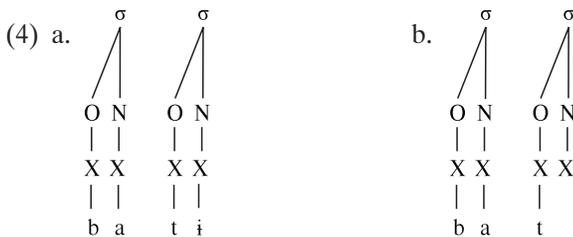
In fast speech, the vowel [i] does not surface, and [u] never appears before a word boundary. The examples in (3) show the relevant differences between European Portuguese standard and fast speech.

(3) Vowel reduction in slow and fast speech

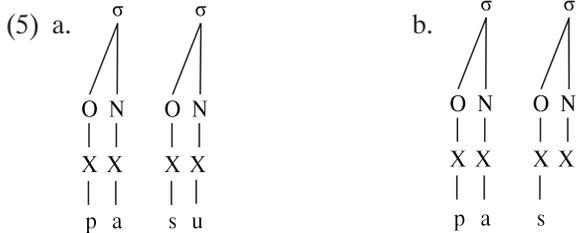
<b>slow speech</b>	<b>fast speech</b>	<b>gloss</b>
bate [ˈbati]	[ˈbat]	's/he beats'
carro [ˈkaru]	[ˈkaɾ]	'car'
chefe [ˈʃɛfi]	[ˈʃɛf]	'boss'
parece [pɐˈɾɛsi]	[pɐˈɾɛs]	's/he appears'

Mateus – d'Andrade (2002) suggest that the syllable structure of Portuguese fast speech and slow speech is identical. Forms in (3) contain *empty nuclei*, that is nuclei included in the prosodic structure, but having no phonetic realisation.

The difference between slow speech [ˈbati] (4a) and fast speech [ˈbat] (4b) is illustrated in (4).



Similarly, (5) presents the syllabic structure of the word *passo* ‘I pass’ in the two variants.



Mateus – d’Andrade (2002) provide a number of independent arguments to support the employment of *empty nuclei*. One of them addresses the difference in the acquisition of forms such as *prato* [‘pratu] ‘dish’ and *pneu* [‘pnew] ‘tyre’.

The initial cluster in *prato* satisfies both the Sonority Sequencing Generalisation (SSG, Jespersen 1904), which states that the sonority of segments must rise towards the syllable nucleus<sup>7</sup>, and the Minimal Sonority Distance<sup>8</sup> (MSD) principle, which requires two segments belonging to the same syllable constituent to have a fixed sonority difference.

While the SSG is universal, the MSD is language-specific. As argued by Mateus – d’Andrade (2002), Portuguese requires that the distance on the sonority scale between two consonants in the same constituent must be higher than one.

Assuming the following scale, starting from the least sonorous segments: obstruents-nasals-liquids-glides-vowels, it becomes apparent that the cluster *pn-* in *pneu* ‘tyre’ violates the MSD, as the sonority distance between the obstruent *p* and the nasal *n* equals one. This means that *pn-* is not an admissible onset in the language, in contrast to the onset in *prato*, which is well-formed because the sonority distance in the *pr-* cluster equals two.

The argument here is that while children learning Portuguese have no trouble pronouncing ‘possible’ clusters, such as *pr-* in *prato* ‘dish’, they insert a vowel to split offending clusters. Thus, the form *pneu* often surfaces as [pi’new], but *prato* is never rendered as \*[pi’rato].

A similar observation applies to certain dialects of Portuguese. In colloquial speech in the European variant, speakers often apply the same repair strategy as discussed above, i.e. they insert the vowel [i]. An analogous process occurs in Brazilian Portuguese, where unacceptable clusters are invariably separated by the vowel [i]. Thus, *pneu* surfaces as [pi’new]. On the other hand, \*[pi’ratu] is unattested.

A third argument is made on the basis of voice assimilation. A coda fricative *s* becomes voiced if the following consonant is voiced, as evidenced

in *mesmo* [ˈmezmu] ‘same’ or *mais barato* [ˈmajʒ beˈratu] ‘cheaper’.<sup>9</sup>

However, there is no voicing in *ritmo* [ˈritmu] ‘rhythm’. To account for the absence of voicing, the sound *t* cannot be part of the coda; otherwise the surface representation \*[ˈridmu] would be obtained<sup>10</sup>.

These arguments in favour of empty slots are not entirely convincing. For one thing, it seems highly controversial to draw on evidence from one dialect or speech variant to construct generalisations about another dialect. However, the purpose of this article is to show that, even with these hypotheses about the structure of Portuguese, it is not possible to conduct a tenable analysis of Vowel Reduction in the proposed framework.

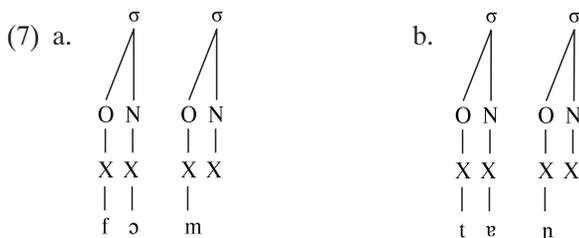
### 3. Nasalisation

Portuguese has the rule of Vowel Nasalisation: a vowel becomes nasalised when followed by a tautosyllabic nasal consonant. This is clearly illustrated by the pair of indefinite articles given in (6). The pair also shows that Nasalisation does not occur if the vowel and the nasal consonant do not belong to the same syllable. The dot marks the syllable boundary.

- (6) um [ũ]                      masculine indefinite article  
       uma [u.m̃]                feminine indefinite article

The examples in (6) lead us to believe that nasal vowels are absent from the inventory of underlying segments in Portuguese. Thus, for instance the word *som* [ˈsõ] ‘sound’ is, underlyingly, //son//.<sup>11</sup>

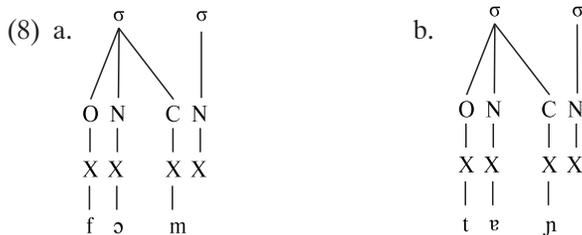
Bearing in mind that Nasalisation only occurs if the vowel and the nasal belong to the same syllable, let us consider some examples with a word-final [i] or [u] preceded by a nasal. Recall that Portuguese deletes these vowels in the word-final position in fast speech. The syllable structure remains unchanged, because, as may be concluded from Mateus – d’Andrade’s analysis, an empty nucleus is retained in place of the deleted vowel. (7) presents a fast-speech structure of the words *fome* ([ˈfõmi] in slow speech) ‘hunger’ and *tenho* ([ˈtõɲu] in slow speech) ‘I have’. Once again I omit the rhyme node.



In (7), the context for Nasalisation is not met, as the nasals and the vowels that precede them belong to different syllables. Therefore, the prediction is that the words should be pronounced, respectively, \*[fɔm] and \*[tɛj]. In fact, this observation does not agree with the phonetic facts of Portuguese fast speech.

When producing such examples, native speakers delete the final vowel and nasalise the vowel of the preceding syllable. Since Nasalisation occurs, the nasal consonant must crucially be syllabified into the coda, because, as shown in (6), a nasal does not trigger Nasalisation if it belongs to the onset of the following syllable.

Therefore, a rule of resyllabification must be posited: a nasal consonant preceding a word-final empty nucleus must be resyllabified into the coda of the penultimate syllable. Such a rule would result in the forms given in (8).



That such syllabic structures can exist is highly improbable from the perspective of language typology. To the best of my knowledge, no language syllabifies the sequence CVCV as CVC.V, much less introduces a process changing the syllabification CV.CV to CVC.V.

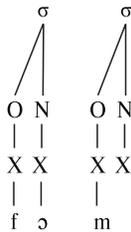
The aforementioned facts cast doubt on the view that the syllabic structure of Portuguese fast and slow speech is identical. However, in order to salvage that claim, let us consider the possibility that fast speech requires a slight modification, which is expressed in (9).

(9) Empty Nucleus Constraint

*Empty Nuclei are not permitted word-finally.*

The constraint given in (9) enables us to account for the examples in (7), i.e. *fome* ‘hunger’ and *tenho* ‘I have’ pronounced in fast speech as [fõ] and [tɛj].<sup>12</sup> The Empty Nucleus Constraint eliminates the entire prosodic structure of the deleted word-final vowel, hence the nasal consonant ends up unprosodified, and has no other option but to be joined to the coda of the preceding syllable. The final stages of the derivation of *fome* ‘hunger’ are shown in (10).

(10)



Input (empty nucleus instead of word-final /i/)



Empty Nucleus Constraint (9)



Resyllabification



Vowel Nasalisation

Owing to the constraint in (9), it is now possible to predict the correct output in the case of examples such as *tenho* ‘I have’ and *fome* ‘hunger’. The Empty Nucleus Constraint forces the syllabification of [m] into the coda. *Ergo*, the context for Vowel Nasalisation is met.

However, the analysis presented above introduces a major change of the syllable structure of Portuguese. Note that if [m] is ultimately syllabified into the coda, so should be all the remaining consonants which precede a word-final empty nucleus. Consider examples such as *carro* ‘car’ and *parque* ‘park’, in slow speech respectively, [‘karu] and [‘parki]. The analysis of the former, which is analogous to the example *fome* ‘hunger’, is given in (11).

(11)



Input (empty nucleus instead of word-final /u/)



Empty Nucleus Constraint (9)



Resyllabification

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Vowel Nasalisation

As can be observed, the liquid [r] is a member of the syllable coda. By the same token, in *parque* ‘park’ we would have to syllabify [k] to the coda of the first syllable. This contradicts the initial claim put forward by Mateus – d’Andrade (2002), namely that only three segments are acceptable in the coda: [l r j]. Recall that according to these authors, the generalisation is valid for both slow and fast speech.

#### 4. Conclusions

It has been argued that the syllable structure of standard and fast speech European Portuguese cannot be considered identical from the perspective of the skeletal theory. If that were the case, the existence of empty nuclei would successfully account for the discrepancies in the data (cf. *bato* ‘I beat’ – [‘batu] in slow speech, [‘bat] in fast speech). However, as has been shown, the

process of Vowel Nasalisation challenges the claim that the two systems are indeed parallel. Modifications suggested in the previous section, including the *Empty Nucleus Constraint*, enable us to correctly predict nasalisation, but at the same time require a modification of the shape of the coda in fast speech.

All in all, it must be posited that the two speech tempos under discussion have separate syllable systems. In particular, fast speech does not possess rigid limitations on the shape of each syllable constituent, such as the ones found in slow speech or in other Romance languages. Further, there is no reason to forbid the syllabification of *ritmo* ‘rhythm’ with *t* and *m* belonging to separate syllables: [‘rit.mu]. Lack of voicing before the nasal consonant would simply require the rule of coda voice assimilation to apply solely to *s* (see endnote 10).

An outstanding issue is the generalisations mentioned in section 2., namely the different rendering, in the context of language acquisition, of the initial clusters in forms such as *prato* ‘dish’ [‘pratu] and *pneu* ‘tyre’ [pi’new]. To the best of my knowledge, no solution has been suggested as an alternative to the analysis presented by Mateus – d’Andrade (2002). Additional research in this area is required.

## NOTES

<sup>1</sup> I would like to thank the two anonymous reviewers for their discussion and criticism, which led to considerable improvement of both the content and the presentation of my analysis.

<sup>2</sup> In this article, the skeletal tier is represented by means of X-slots, rather than CV-constituents. Representations employing moras may obscure the picture, hence moraic theory is disregarded.

<sup>3</sup> [ʃ] undergoes voicing to [ʒ] if the following consonant is voiced.

<sup>4</sup> [i] is absent from the inventory of fast speech Portuguese; in slow speech, it appears solely in unstressed positions.

<sup>5</sup> Most data and generalisations come from Mateus – d’Andrade (2002) and Coetzee (2004).

<sup>6</sup> In this example, [a] is the verbalising morpheme, while [r] introduces the infinitive.

<sup>7</sup> Clusters in onset and coda must adhere to the following formula: SFNLGVGLNFS, where S is a stop, F is a fricative, N is a nasal, L is a liquid, G is a glide, and V is a vowel (nucleus).

<sup>8</sup> Mateus – d’Andrade (2002) refer to the requirement as *Dissimilarity Condition*.

<sup>9</sup> Compare *custar* [kuʃ’tar] ‘to cost’ and *lápiz preto* [‘lapif ‘pretu] ‘black pencil’.

<sup>10</sup> One may stipulate that voice assimilation applies only to the fricative [ʃ] in Portuguese and does not affect any other obstruent, which is a viable analysis because it is not contradicted by the data. However, I disregard this observation for now. I will pursue it further in section 4.

<sup>11</sup> The form *sonoro* [su’noru] ‘voiced’ indicates that the consonant in the coda is //n//, rather than some other nasal.

<sup>12</sup> Word-final [v ε e] undergo diphthongisation when they are nasalised. I ignore the issue of which of these vowels is actually present in the Underlying Representation of *tenho* ‘I have’.

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