

There are controversies! The phonological status of nasal vowels  
and their discussion in the literature /  
*Há controvérsias! O estatuto fonológico das vogais nasais e a sua  
discussão na literatura*

*Bruna Teixeira Correa\**

Substitute professor at the Federal Institute of Paraná (Telêmaco Borba/PR/Brazil); Doctoral student at the Postgraduate Program in Letters at the Federal University of Pelotas (Pelotas/RS/Brazil); Master in Language Studies; works in the areas of phonetics and phonology, with a special focus on nasal vowels.

 <https://orcid.org/0000-0003-1433-9411>

*Giovana Ferreira Gonçalves\*\**


Associate Professor at the Federal University of Pelotas; Coordinator of the Oral Language Emergency Laboratory (LELO/UFPel). I use to develop research in Phonology, focusing on phonological theories and phonological acquisition of first and foreign languages. In my academic career, I published works whose analyzes were carried out under different theoretical models, with emphasis on Optimity Theory. In the last ten years, I has focused my research on studies in Articulatory Phonology.

 <https://orcid.org/0000-0002-3237-0255>

*Izabel Christine Seara\*\*\**

Full Professor at the Federal University of Santa Catarina. Post-Doctorate at Université Paris 3 - Sorbonne Nouvelle (Paris-France -2012) and at the University of Aveiro (Portugal -2019). She works at the Undergraduate Program in Portuguese Language Arts and at the Postgraduate Program in Linguistics in the area: Linguistic Theory and Analysis. Research topics: intonation -prosody and its interfaces, acoustic-aerodynamic-articulatory detailing of speech sounds, speech synthesis and recognition, French/Brazilian Portuguese interphonology, and is currently initiating research on indigenous languages (Guarani). Sorbonne Nouvelle (Paris-France -2012) and at the University of Aveiro (Portugal -2019). She works at the Undergraduate Program in Portuguese Language Arts and at the Postgraduate Program in Linguistics in the area: Linguistic Theory and Analysis. Research topics: intonation -prosody and its interfaces, acoustic-aerodynamic-articulatory detailing of speech sounds, speech

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\*  [correatbruna@gmail.com](mailto:correatbruna@gmail.com)

\*\*  [giovanaferreiragoncalves@gmail.com](mailto:giovanaferreiragoncalves@gmail.com)

\*\*\*  [izabel.seara@ufsc.br](mailto:izabel.seara@ufsc.br)

synthesis and recognition, French/Brazilian Portuguese interphonology, and is currently initiating research on indigenous languages (Guarani).

 <https://orcid.org/0000-0001-9204-9730>

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#### ABSTRACT

This article aims to survey the main studies that discuss the phonological status of nasal vowels in Portuguese and to reflect upon the positions defended by their authors. The relevance of this study lies in that (1) it evinces novel and underdiscussed aspects of arguments widely disseminated and accepted in the area regarding the phonological nature of these segments; and (2) it critically gathers the main studies on the subject. There are currently three main conceptions about the phonological nature of Portuguese nasal vowels: The biphonemic, that is, an oral vowel followed by a nasal consonant (/VN/), whose argument is based on structural aspects of the Portuguese language and comparisons with the French language; the monophonemic, in other words, a full nasal vowel (/ṽ/); and the biphonemic composed of two vowels, one oral and one nasal (/V+ṽ/). The last two conceptions bring experimental evidence more expressively. The theoretical survey carried out and the reflections showed that, regardless of the phonological hypothesis defended and the theoretical perspective of its defenders, there are arguments that can be questioned, especially in view of the theoretical, technological, and experimental advances that the field has witnessed in the past few decades.

**KEYWORDS:** Phonological status; Portuguese nasal vowels; Biphonemic; Monophonemic.

#### RESUMO

*O presente artigo tem como objetivo fazer um levantamento dos principais trabalhos que discorrem sobre o estatuto fonológico das vogais nasais do português, bem como tecer reflexões acerca dos posicionamentos defendidos pelos autores. A relevância deste estudo sustenta-se na evidência de aspectos ainda não pensados ou pouco discutidos em relação a argumentos amplamente difundidos e aceitos na área quanto à natureza fonológica desses segmentos, além, é claro, da reunião crítica dos principais trabalhos acerca da temática. Existem, atualmente, três principais concepções acerca da natureza fonológica das vogais nasais do português: a bifonêmica, isto é, uma vogal oral seguida de uma consoante nasal (VN), cuja argumentação tem como base aspectos estruturais da língua portuguesa e comparações com a língua francesa; a monofonêmica, ou seja, uma vogal nasal plena (/ṽ/); e a bifonêmica composta por duas vogais, uma oral e outra nasal (/V+ṽ/), estas duas últimas concepções trazendo de forma mais expressiva o dado experimental na ciência linguística. O levantamento teórico e as reflexões realizadas mostraram que, independentemente da hipótese fonológica defendida e da perspectiva teórica de seus defensores, há argumentos passíveis de questionamentos, tendo em vista, especialmente, os avanços teóricos, tecnológicos e experimentais pelos quais tem passado a área nas últimas décadas.*

**PALAVRAS-CHAVE:** Estatuto fonológico; Vogais nasais do português; Bifonêmico; Monofonêmico.

## 1 Introduction

The phonological status of nasal vowels in Brazilian Portuguese (BP) is widely discussed, but it is still contentious, regardless of the theoretical framework under which it is being observed. It is known that nasal vowels in Portuguese have a distinctive effect—as in *cinto* vs. *cito* (“belt” vs “I cite”) and *junta* vs. *juta* (“joint” vs. “jute”) (CÂMARA JR, 1970)—, similarly to French and differently from English and Spanish, for example. However, what has not been elucidated yet is the nature of this distinctiveness; that is, the phonological representation of these segments in Portuguese. There are two main conceptions shared by scholars in the field regarding the phonological status of the BP nasal vowels: (i) the phonological representation of an oral vowel followed by a nasal consonant (/VN/); and (ii) the existence of a nasal vowel as a phonological unit (/ṽ/). Furthermore, there is also a less widespread concept by Parkinson (1983) and Pimenta (2019) that postulates the existence of a biphonemic nasal vowel composed of an oral vowel and a nasal vowel (/VV/), constituting a diphthong.

The (/VN/) biphonemic hypothesis of nasality in BP is defended by Câmara Jr. (1953), Cagliari (1977), Duarte and Teixeira (1979), Moraes and Wetzels (1992), Bisol (2002), Mateus (1975), Mateus and Andrade (2000), among other authors. For them, full vocal nasality does not exist in BP, as in French, so that there is a distinction between a nasal vowel and a vowel followed by a nasal consonant (*bon* – [bõ] – /bõ/ – “good” / *bonne* – [bɔ̃n] – /bɔ̃n/ – “good”). They argue that the nasal resonance found in the vowel is due to the presence of the following nasal consonant in the same syllable. There are several arguments considered by the authors, which we will discuss in the next section of this paper.

The other one is the monophonemic hypothesis, which is also disseminated by several authors (e.g., LÜDTKE, 1953; PONTES, 1972; COUTO, 1978; TLÁSKAL, 1980; CALLOU; LEITE, 1990; COSTA; FREITAS, 2001). This assumption defends the existence of full nasal vowels in the language. There are also several arguments supporting this conception, among which are those put forward by Lüdtke (1953). According to the author, two aspects could be pointed in evidence: the existence of minimal pairs formed with the nasal vocalic segments and, for European Portuguese (EP), the impossibility of the vowels /a/ or /e/ and /ɛ/ to work (in unstressed position) as allophones of the same preceding and following contexts. Thus, minimal pairs like *tampar* /tẽpar/ vs. *tapar* /tɛpar/ (“to cap” vs.

“to cover”), exist in unstressed position, and both *tanto* /tẽto/ vs. *tato* /tato/ (“much” vs. “touch”), in stressed position, which work as phonemes since they lead to differences in meaning.

In contrast to the literature of the area, Parkinson (1983) – and, also, Pimenta (2019) – postulates that the vowels and nasal diphthongs of EP have a biphonemic status. According to them, nasal vowels are true diphthongs, i.e. they consist of two vowels, one oral and one nasal, what he calls “intermediate position”, VV. Other authors do not seem to share Parkinson's idea; therefore, his theory is not very widespread. According to the author, oral diphthongs (e.g., *peito*, “breast”), nasal monophthongs (e.g., *fã*, “fan”), and nasal diphthongs (e.g., *pão*, “bread”) derive from the same phonological structure – that is, V+V in an open syllable – and thus have a complex syllabic nucleus. For this conception, the difference between diphthongs formed by semivowels (which are considered consonants) constituted of closed syllables and those formed by open syllables is in the quality of the second element of the phonological structure, not in the quantity of these elements.

Considering these three conceptions about the phonological constitution of nasal vowels in Portuguese, this paper aims to review the arguments that support their hypotheses, as well as to comment on possible controversies made by the authors in their discussions. The text will be divided into five sections, including the introduction, one section for each theoretical conception under investigation, and some concluding remarks in which we will present our position based on the discussion of the state of the art presented here. We certainly do not intend to provide a final answer to the issue of the phonological representation of nasal vowels in Portuguese; rather, we intend to highlight aspects that have not been thought of or have been briefly discussed in relation to arguments widely disseminated and accepted in the field regarding the phonological nature of these segments. With this, and in view of so many technological and experimental advances, we hope to add to the discussion and to future positionings on this topic.

## 2 The (/VN/) biphonemic status

The biphonemic hypothesis for nasality in BP is defended by scholars such as Câmara Jr. (1953), Cagliari (1977), Duarte and Teixeira (1979), Moraes and Wetzels (1992), Bisol (2002), Mateus

(1975), Mateus and Andrade (2000). As mentioned before, according to this perspective there are no full nasal vowels, but oral vowels followed by a nasal consonant in the same syllable. In order to defend this hypothesis, the aforementioned authors list arguments, most of them of structural order. We will order them according to their date of publication.

Câmara Jr. (1953) refers to the Portuguese nasal vowels as a "problem" and proposes the existence of two types of nasality in the language. According to the author, in the merely phonetic and mechanical nasality, as in *ano* ("year") and *tema* ("theme"), the speaker "does not feel" (our translation) the functional nasality in the language, unlike what occurs in the phonological nasality, in which there is distinction of meaning. Couto (1978) mentions the arguments to be avoided in this discussion, and one of them is the psychological argument. After all, what is "feeling" nasality? Was Câmara Jr. talking about perception? Years later, Câmara Jr. himself condemned this kind of argument: "modern linguistics puts aside this kind of rationale, which appeals to the 'feeling' of the speaker" (1970, p. 49, our translation). However, "not feeling" the nasality may simply be related to something the speaker does not plan to accomplish, there being no intention to nasalize the vowel. It does not seem to us that "feeling" the nasality can be seen as a psychological argument, but as another way to report the performance of mechanical – for contextual reasons – or intentional gestures (SOLE, 2007).

The main question for Câmara Jr. is then to discover, among the types of nasality presented, what is the specific feature a vowel has in phonemic terms, which makes it phonological. His view is that this distinctive feature is in the syllable a division spontaneously established by native speakers of a language and strongly "felt" by them (CÂMARA JR., 1977, p. 53). Therefore, nasal vowels are understood as consisting of a vowel (V) and a nasal consonant (Cn), both in the same syllable. He proposes that the nasal resonance of the vowel is explained by the presence of the archiphoneme /N/, whose point of articulation is not specified and that will only be established according to the context, forming a dental [n], labial [m], or palatal [ɲ] consonant. However, it is important to note that more recent work (SOUSA, 1994; SEARA, 2000; BARBOSA, MADUREIRA, 2015) points out that nasal vowels preceding fricatives, nasal vowels do not present murmur, a phase commonly linked to the nasal consonant predicted by the biphonemic status. Where would be murmur, i.e., the nasal resonance of /N/ expected in these cases? In a perceptual study, Marques and Scarborough (2020)

observed that the presence of nasal resonance, the murmur, does not interfere with the perception of a nasal vowel in Portuguese. Thus, according to their results, nasality is inherent to the vowel itself.

To defend his idea, Câmara Jr. lists arguments based on the structure of Portuguese and on comparisons with other Romance languages. The first argument concerns the syllable where this segment appears, as it functions as a syllable closed by a consonant, as it occurs with /l/, /z/, and /r/. In general, elision occurs in EP when one word ends and the other begins with a vowel, as in *grande amor* (“great love”), produced as *grand'amor*. The same does not occur in relation to what would be considered nasal vowels. There will be no elision in *lã azul* (“blue wool”) or in *jovem amigo* (“young friend”), for example. Nevertheless, we point out that the absence of a sandhi process in *lã azul*, for example, as opposed to its occurrence in *grande amor*, can be simply explained by the distinct nature of the vocalic segments – which would block a process of degemination (BISOL, 1996) – and by the fact that the nasal vowel carries the primary stress – which would also block the process of elision (BISOL, 1996) –, preventing the stress clash that would trigger some possible sandhi process. Therefore, the absence of the sandhi process in such a sequence of lexical items is not related to the presence of a nasal consonant in the phonological representation.

Tláskal (1980) seeks counter-arguments in French, a language in which most scholars undoubtedly agree on the existence of phonological nasal vowels. In the case of the aforementioned argument concerning the syllable closed by a consonant, which was also used later by Barbosa (1965), Tláskal (1980) recalls that, in French, a nasal vowel preceding an oral vowel completely or partially loses its nasality, generating a full nasal consonant interspersed between two vowels, as in *mon ami* – [mɔnami] (“my friend”). Considering the emergence of a nasal consonant as onset of the following syllable, the example reported by Tláskal (op. cit) would actually be much more convincing to argue for the presence of biphonemic vowels in French than the one presented by Câmara Jr. for Portuguese. As such, external juncture processes do not seem the most appropriate to highlight the status of vocalic nasality. Parkinson (1983) further argues that the facts are treated in a very simple way, which is not what happens in relation to crasis. For him, there are different degrees of elision and a scale of resistance to contraction, which considers parameters like stress, for example. According to the author, falling diphthongs and nasal vowels are the most resistant elements, which is an indication that they

derive from the same basis. He also recalls the work of Almeida (1976) who, after realizing that stress inhibited contraction, recorded and transcribed the sentence *esta lã azul é uma porcaria* ("this blue wool is awful"), placing the famous sequence *lã azul* in a context that did not attract the stress. Almeida found the contraction, which, in theory, would nullify Câmara Jr.'s argument.

The second argument used by Câmara Jr. is related to the phonetic realization of the rhotic in Portuguese. Between vowels, there is the realization of the weak r, as in *cara* ("face"); however, it is not what occurs when there is a nasal vowel in adjacent position, as in *honra* ("honor") and *genro* ("son-in-law"). In the latter cases, there is the realization of the strong r, indicating, according to the author, that there is a consonant closing the syllable – and not a nasal vowel – because if there were only a vowel, the weak r would be produced following the language pattern. Contrary to this argument, we emphasize, in agreement with Head (1964, apud FONSECA (1984)), that, in Portuguese, there is also the occurrence of the strong r between vowels in many words of the language, such as *carro* ("car"), *barriga* ("belly") and *gorro* ("beanie"), and its distribution in this context is productive. Thus, its emergence would also be expected following monophonemic nasals.

It is worth noting that lexical items with closed syllables followed by the strong r are not very frequent in Portuguese, e.g., *bilro* ("bobbin lace"), *chilrear* ("to tweet"), *melro* ("blackbird"), *guelra* ("gill"), and *palrear* ("to talk"). The frequency of words like *genro* ("son-in-law"), *tenro* ("tender") and *honra* ("honor") is therefore better matched with the distribution found in open syllables. Fonseca (1964) points out that Câmara Jr. did not question the presence of the strong r following open syllables, but the absence of the weak r in this position, which would rule out the criticism made here. However, the distributional restriction of the weak r in Portuguese does not occur only when it follows nasal vowels or syllables closed by a lateral or sibilant, but it is also present in other contexts, such as the beginning of a word or following diphthongs in complex codas, as in \*airs. Câmara Jr. (1970) considers that falling diphthongs in Portuguese constitute open syllables, so the absence of the weak r following open syllables must also be considered.

The third argument concerns the formation of hiatuses in Portuguese. According to Câmara Jr. (1970), there are no nasal vowels in this type of vowel formation. For the author, hiatuses in Portuguese were avoided by the consonant nasal glide, via evolution from Latin, as in *ua* > *uma*. A full

nasal consonant was then developed and passed on to the next syllable, affecting the level of nasalization of the previous vowel. Thus, only two results may be obtained when there is a nasal vowel involved:

- (i) the nasal vowel disappears, as in *bom* – *boa* (“good”); and
- (ii) the nasal consonantal element goes to the next syllable, as in *valentão* – *valentona* (“bully boy”).

Therefore, the absence of nasal vowels in hiatuses means that there is, in fact, the nasal archiphoneme /N/, which works as any other nasal consonant placed between vowels, belonging to the next syllable – *um*, and not *u-ma* (“one”), as in *a-sa* (“wing”), *a-ço* (“steel”) (CÂMARA JR., 1953, p. 60).

Still on the displacement of the consonantal element to the next syllable, Mateus (1975) makes use of prefix derivations (*importante*, *inacabado*) (“important, unfinished”) and semantic relatedness (*fim* – *finalizar*) (“finish, finalize”) to support his hypothesis of the biphonemic status of nasal vowels. However, Tláskal (1980) points out that the same occurs in French: *impressioné*, *inadaptable*, and *fin* – *finir*, *don* – *donner*, *son* – *sonner*. Similarly, the author believes that Barbosa’s (1962, 1965) argument on nasalized vowels, as in *ano* (“year”) – where the preceding vowel is nasalized by the following nasal consonant and is therefore phonetic in origin –, does not support the biphonemic hypothesis for nasal vowels. For him, having a heterosyllabic nasal consonant only strengthens the fact that the nasalized vowel is a variant of the oral vowel. Thus, for Tláskal (1980), the major problem with Câmara Jr.’s (1953), Mateus’s (1975), and Barbosa’s (1962, 1965) analyses is that they are not based on the phonetic manifestations of the language; that is, they consider more important the manifestations at the abstract level, which have very little in common with the living language. The fourth argument used by Câmara Jr. (1953) is related to the phenomenon of liaison. In Portuguese, the liaison of two words occurs when one ends in consonant and the other begins with a vowel, as in *mar alto* (“high tide”), which becomes *ma-ral-to* ([ma'rawtu]). Similarly, resyllabication occurs with the nasal vowels, as in *vim aqui* (“I came here”), which becomes *vi-nha-qui* ([vĩna'ki]), with the occurrence of a palatal sound.



Hence, it is again understood that there is a syllable closed by the nasal archiphoneme /N/. Nevertheless, the same occurs in French with its monophonemic vowels: In the sequence *un ami* (“a friend”), which is produced as [ẽ.na.mi], in front of a vowel, the nasal consonant appears and resyllabation occurs because of the liaison, in this case, mandatory.

Finally, Câmara Jr. (1953) uses the example of the phonetic realization of /s/ in *pensar* (“to think”) to explain that the lack of voicing of the intervocalic consonant indicates that the syllable preceding it is closed, i.e., it contains a nasal consonant, which points to the biphonemic status, unlike what occurs in *pesar* (“to weigh”), for example. However, Tláskal (1980) reminds us that the same occurs in French – *penser* – and that Câmara Jr. (1953) does not doubt the existence of nasal vowels in French. Moreover, we find examples of voiced consonants between a nasal and an oral vowel in Portuguese too, as in *transe* (“trance”), *trânsito* (“transit”), and *transitar* (“to transit”). This argument is abandoned by Câmara Jr. (1977) in a later work, in which he makes a synchronic analysis of vocalic nasality.

Similarly, to what Câmara Jr. (1953) predicts, Cagliari (1977) also argues in his doctoral dissertation that the representation of nasal vowels includes the archiphoneme /N/; thus, a biphonemic status. Cagliari (1977) quotes Strevens (1954) to explain that there are two degrees of nasality in Portuguese. The stronger one, also known as “second degré”, characterizes nasal vowels as phonologically significant; the other, on the contrary, has no phonological significance and corresponds to nasalized vowels. According to Strevens (1954 apud CAGLIARI, 1977, p. 22), the second degree of nasality is much stronger, and, as such, it has much more nasal resonance. To produce it, the speaker has to produce as much nasality as possible for that sound to be acceptable and distinctive in the language, so the soft palate is lowered to its maximum. It is now known that, besides the differences in degrees of opening for the different types of nasality – contrastive, as in *canto* (“corner”); allophonic, as in *cama* (“bed”); coarticulatory, as in *mato* (“bush”) – addressed by Moraes (2013), there are also different degrees of opening within the category of contrastive nasality. In other words, it is not always necessary to lower the soft palate all the way for a nasal vowel to be distinctive for there is much variation, including among the nasal vowels of the system (MEDEIROS; DEMOLIN, 2006). Unlike Câmara Jr. (1953), Cagliari does not present new arguments to defend the biphonemic status; he only

shares Mattoso's arguments and focuses on the use of different technologies to make a detailed description of these segments. Nevertheless, he claims that the BP vocalic nasality is much more complex than the dataset with which Mattoso conducted his research (CAGLIARI; MASSINI-CAGLIARI, 2007).

Moraes and Wetzels (1992) share the same conception about the status of these segments and consider nasal vowels the "most controversial problem in Portuguese phonology" (p. 153, our translation). They focus on phonetics and on an instrumental analysis to discuss whether contrastive nasality derives from V or VN, and highlight the fact that their work fits within the premises of Experimental Phonology, or Laboratory Phonology, to validate experimentally tested hypotheses on phonological issues – Portuguese nasal vowels in this case. Therefore, they observed the duration of nasal and nasalized vocalic segments as opposed to oral segments to seek evidence "on the question of which solution is, from a phonetic point of view, preferable regarding the mono- or biphonemic interpretation of nasal vowels" (p. 157, our translation).

To do so, they examined the duration of nasal, nasalized, and oral vocalic segments produced in the carrier sentence *É melhor dizer de novo* ("It's better to say again"). Two corpora were organized for this purpose. The first contained 32 target words, all with [a], as in *cama* ("bed") and *camba* ("camshaft"). The preceding and following contexts (half voiceless and half voiced), and the influence of the stress context (unstressed and stressed) were controlled. The second corpus contained 40 words also with [a] in its oral, nasal and nasalized forms, in stressed position, in front of a fricative, and in final position, as in *vã* ("vain") and *vá* ("go"). The corpora were read by two students from the City of Rio de Janeiro. The following parameters were measured: Vocalic segment duration; nasal murmur duration, if any – which was added to the duration of the vocalic segment –, and the subsequent consonant duration.

They obtained the following results, which were used as arguments for their interpretation of nasal vowels:

(i) the nasal vowel is longer than the oral vowel (27% in stressed context and 74% in unstressed context);

(ii) the nasalized vowel is slightly shorter than the oral vowel.

The authors believe that these effects are in line with the phonological explanation for the longer duration of nasal vowels. Put differently, there is a compensatory lengthening in which the nasal consonant, postulated as the basis for contrastive nasality, is suppressed from the phonetic representation, transferring its [+nasal] feature to the preceding vowel, leaving only the longer duration as a trace on the surface. They thus assume that these results seem to corroborate the phonetic reality of the temporal layer and the underlying representation of nasal vocalic segments as biphonemic, i.e., V+N. In French, several works also point to the longer duration of nasal vowels (DELVAUX, 2003; TEIXEIRA-CORREA, 2017), although there is no suppressed nasal consonant for these segments in the language.

Furthermore, when looking at the duration of consonants following oral and nasal vowels, they noted that (iii) when the duration of the nasal vowel is lengthened in relation to the corresponding oral vowel, there is actually a subtraction of the duration of the consonant following the oral vowel, so that the duration of an oral vowel + following consonant becomes practically equal to that of a nasal vowel + following consonant. This third finding, according to the authors, affects the first two because the increase in vowel duration when preceding a plosive could be phonologically interpreted as belonging to the following segment; that is, it would be a coarticulatory pre-nasalization of the following plosive.

The results of the second corpus showed that (iv) the phenomenon of nasal vowel lengthening in stressed position and the reduction of the following consonant do not occur when there is a fricative after. In this case, there is even (v) a slight reduction of the nasal vowel in relation to the oral vowel. According to the authors, these results do not endorse the biphonemic status, but they do not discard it either, thus requiring the formulation of new rules that account for these phonetic facts.

According to Moraes and Wetzels (1992), the last result also corroborates the biphonemic interpretation (oral vowel + nasal consonant) of vowel nasality in Portuguese: (vi) The stressed oral and the nasalized vowels in open syllables are significantly longer when compared to the corresponding unstressed vowels, 70.5% on average. However, the nasal vowels in unstressed position are slightly, though systematically, longer than the corresponding oral (23.9%) and nasalized (35.7%) vowels.

Mateus and Andrade (2000) assume that there are no underlying nasal vowels in Portuguese. Based on the Autosegmental Theory, they present three arguments that are actually the same as those already mentioned and presented by precursor scholars. The first argument concerns the pronunciation of the rhotic after a nasal vowel, which will be realized as [R], an expected pattern for a syllable ending by a consonant, as in *enrolo* (“I roll”), and not by a vowel, where the pattern would be [r], as in *coral* (“coral”).

The second argument concerns the prefixes *in-* and *im-*, whose behavior is different depending on the following context. For example, in *intenção* (“intention”), a nasal vowel is produced since following context is consonantal; in *inacabado* (“unfinished”), an oral vowel is produced followed by a nasal consonant, that is, the vowel nasality disappears since the following context is vocalic. The same occurs with diphthongs, as in *som – sonoro* (“sound – audio”), *leão – leonine* (“lion – leonine”), where it is also clear that the result is an oral vowel followed by a nasal consonant because its derivation comes from underlying forms that carry /N/, such as /'soN/ and /le'aoN/. The authors explain that these prefixes have only one underlying form, which is perceived phonetically distinctively because of the adjacent context.

The third argument is related to the fact that proparoxytones do not occur if the penultimate syllable of the word has a nasal vowel – rá[pi]do, but not \*ra[pĩ]du (“fast”). This is, according to the authors, because pre-final heavy syllables attract the stress. Since nasal vowels contain a nasal consonant in the underlying representation, they attract the stress. However, in addition to closed syllables, open syllables consisting of falling diphthongs are also not present in posttonic non-final position of proparoxytone words. According to Pimenta (2019), nasal vowels, among other distributional similarities, present the same durational pattern as falling diphthongs in Portuguese, thus signaling for the constitution of branched rhymes. Therefore, the last argument presented by Mateus and Andrade (2000) does not necessarily support the presence of a consonant following the nasal vowel.

Nasality is characterized by the authors as “one of the most challenging aspects of Portuguese” (MATEUS; ANDRADE, 2000, p. 130). They say that the process is, in fact, the spreading of the [nasal]

feature of a floating autosegment to the preceding syllable, which seeks anchorage to some constituent of the syllable, and may even be elided.

From a Lexical Phonology perspective, Bisol (1998, 1999ab, 2002) cites Câmara Jr. (1977) and shares the same conception of the phonological status of nasal vowels that he does; namely, the biphonemic (V + Cn) status. However, although Bisol follows the same assumptions as Câmara Jr., she analyzes the issue based on Lexical Phonology and understands that phonological nasalization occurs in two processes: Lexical and post-lexical, or stability and assimilation, or nasal diphthong and nasal vowel, respectively. The first "disassociates the tautosyllabic nasal, without articulatory features, to reassociate it to the rhyme, from where it percolates to the terminal elements" (BISOL, 2002, p. 503, our translation) generating nasal diphthongs. The second is a process of assimilation in N, which spreads to the preceding vowel, generates nasal vowels and occurs in other contexts. In both cases, however, an underlying oral vowel followed by an underspecified nasal consonant is assumed.

Bisol (2002) presents the same arguments used by Câmara Jr. to support the biphonemic status:

- (i) the absence of nasal vowel in hiatus;
  - (ii) the denasalization of the prefix *-in* when it precedes the liquid, as *in + legal = ilegal* ("illegal");
- and
- (iii) the realization of the strong vibrant after the nasal vowel, as in *genro* ("son-in-law").

Bisol further adds the impossibility of a sandhi process, as in *lã amarela* – \*[lãmarela] ("yellow wool"), and the absence of nasal vowel in the pre-final syllable of proparoxytones, as in "capénga", and not "cápenga" ("lame") – an argument previously presented in Mateus and Andrade (2000).

Based on the fact that the nasal vowel is constituted by assimilation of a following nasal consonant, Bisol (2002; as well as CÂMARA JR., 1977) explains that the variants of /N/ are conditioned by the neighboring segments, i.e., by the posterior obstruent, as in *taNgo* > *tango* > *tã:go* ("tango"), where there is an internal nasal that can be deleted with compensatory duration; or by the preceding vowel, as in *omeN* > *omey* > *omen* ("man") with the realization of a glide with a homorganic vowel. For

the author, it is in the post-lexical component – that is, after the formation of the word – that the specification of /N/ occurs. The possibility of variation in stressed and unstressed syllables is an indication of its post-lexical nature. Furthermore, Bisol (2002), as well as Mateus and Andrade (2000), argues that lexical nasal vowels do not exist in Portuguese; that is, this segment cannot be the syllabic nucleus, and it is represented by the /VN/ structure at the underlying level.

Regardless of the theoretical approach adopted, the authors listed in this section do not postulate the existence of an underlying full nasal vowel as in French. For them, phonologically, there is an oral vowel followed by a nasal consonant. The arguments presented for the biphonemic hypothesis sometimes converge among the authors reported here. In the following section, we will present some of the literature that defends the monophonemic hypothesis of nasal vowels in Portuguese.

### 3 The (VN) monophonemic status

The monophonemic hypothesis of nasality, which considers nasal vowels phonologically full, is defended by a smaller number of scholars (LÜDTKE, 1953; TLÁSKAL, 1980; COSTA; FREITAS, 2001; ÁVILA, 2019; MARQUES; SCARBOROUGH, 2020). Lüdtkke (1953, p. 211, our translation) is one of the authors who claims that nasal vowels are "the most conspicuous examples of ambiguous phonematic interpretation" and, like others, argues that the phonological status of these segments is monophonemic. His arguments to defend the monophonemic hypothesis are based on (i) the minimal pairs formed with the nasal vocalic segments and (ii) their tonicity position. At the time, he pointed it out the fact that nasal vowels were developing diachronically in order to form independent phonemes, although this had not yet occurred. The author says it is possible to predict that, at some point, Portuguese will have the same opposition found in French (*beau* /bo/ – *bon* /bõ/ – *bonne* /bõn/), that is, oral vowel: nasal vowel: oral vowel + nasal consonant. By this way, it is possible to consider a future opposition at the system between a nasal vowel and an oral vowel + nasal consonant, as *afim* /e.'fi/ vs. *afine* /e.'fin/ ("suchlike" vs "tune"). Thus, according to Lüdtkke, Portuguese nasal vowels "would figure as completely autonomous entities in the phonematic system" (p. 213, our translation).

Despite indicating his analysis criteria, such as the distinctiveness presented in relation to oral vowels, which supports his monophonemic interpretation – but which is also used by other authors to support the biphonemic status –, Lüdtke (1953) does not advance in the development of other arguments. It has long been known that nasal vowels in Portuguese are distinctive. What we still do not know is the nature of this distinctiveness. As for the second criterion, concerning the tonicity, he only mentions the impossibility of the vowels /a/ or /e/ and /ẽ/ functioning as allophones in the same context. We can infer, from this information, the existence of minimal pairs like *tampar* /tẽpar/ vs. *tapar* /təpar/ (“to cap” vs. “to cover”), in unstressed position, and *tanto* /tẽto/ vs. *tato* /təto/ (“much” vs. “touch”), in stressed position, which indicate that the segments are functioning as phonemes, not as allophones. In our opinion, Lüdtke's (1953) analysis is weak. The arguments used by the author only identify that there is distinctive vocalic nasality in Portuguese. However, the question is how to interpret these vowels phonologically. For that, it would be necessary to have more explanations about the contexts in which these segments appear in the language, their syllabic position, their tonicity possibilities, processes in which they may occur or vary, and comparisons with other languages, which Câmara Jr. (1953) does in relation to BP in the same year.

Almost three decades later, Tláskal (1980) makes one of the most interesting contributions related to the monophonemic status of nasal vowels. He presents a dynamic view of these segments in Portuguese and states that phonological interpretations cannot underestimate the concrete phonetic manifestations of a language if the goal is to seek correspondence in linguistic reality.

According to the author, the nasal vowel system of Portuguese cannot receive only **one** (our emphasis) interpretation for all the variability it presents. For Tláskal, the dynamic solution to the problem, based on the Prague School precepts, corresponds to the real trend of spoken language, which aims at the monophonemic realization of nasal vowels in all types of phonetic contexts. Thus, in the center would be the pure nasal vowels and, on the periphery, “the decentralizing and fugitive phenomena of denasalization identified in the Brazilian popular language” (TLÁSKAL, 1980, p. 567, our translation). For the author, therefore, the vocalic nasality can occur in five levels:

(i) A pure nasal vowel before a pause, as in *lã* (“wool”) and *vim* (“I came”), and sometimes also before a fricative, as in *trânsito* (“transit”) (which is in the center, forming a direct opposition to the oral vowel);

(ii) a nasal vowel + a nasal glide before a non-occlusive consonant, as in *lançar* (“launch”) and *cânfora* (“camphor”) (in a transitive aspect, since it sometimes appears in the spectrogram);

(iii) a nasal vowel + a nasal consonant, in the form of a consonant murmur before an occlusive, as in *canto* (“corner”) and *campo* (“camp”), considering the nasal consonant as a non-phonologically distinctive element (of peripheral character, since it is hardly perceived by hearing);

(iv) an unstressed nasal vowel that occurs as an oral vowel in BP, as in *ímã* > *íma* (“magnet”) and *órfã* > *órfa* (“orphan”) (a phenomenon that takes place only in spoken language and is not adopted in the written language. Thus, it moves from the center to the periphery); and

(v) vowel nasalization on account of a heterosyllabic nasal consonant that does not undergo modifications, as in *ano* (“year”) and *cama* (“bed”) (only a variant of oral vowels).

Regarding the five distinct levels proposed by Tláskal (1980), it is noteworthy that the full nasal vowel as a phonological representation is recurrent in the first four levels, which is clearly evident in (i) and (iv). In levels (ii) and (iii), the presence of a glide and a nasal consonant, respectively, are explained as a result of the following manner of articulation, and these elements are not distinctive for the language.

According to the author, observing these different concrete manifestations and their different levels of nasalization shows that it is incorrect to have a single interpretation for all these cases. For Tláskal, therefore, the important thing is to establish the central, transitive, and peripheral components of an unbalanced system – the Portuguese nasal vowels – whose movement leads us to the creation of pure nasal vowels.

From the perspective of phonological acquisition, Costa and Freitas (2001) also argue for the monophonemic nature of nasal vowels in their study on EP acquisition. For the authors, nasality is strongly represented in Portuguese children's input, which allows them to observe the stabilization of its functioning in the acquisition process and thus predict what happens in adults' grammar. Their study



aims, among other objectives, to list empirical evidence for the hypotheses discussed in the literature about the phonological nasality of EP. For this purpose, they assume that:

- (i) Children whose input received has no nasal vowels will never produce this type of segment;
- (ii) children who are acquiring a system with nasal vowels will first begin to produce oral vowels and only then will nasal vowels emerge; and
- (iii) the prominence of nasal vowels in the input will be responsible for the conditions of their emergence, that is, the more strongly they are represented in the input, the earlier they will achieve stability in the acquisition process.

They analyzed longitudinal transversal data from ten monolingual Portuguese children aged 0;10 – 4;7. The data was collected in spontaneous situations in sessions lasting about 30 to 60 minutes.

Phonetically, out of a total of 14 vowels in Ep, five are lexically distinct nasal vowels that occur in words without lexical nasal consonants, as in r[õ]da and b[ã]da, opposite to r[o]da (“wheel”) and b[o]da (“wedding”), respectively. Unlike BP, there are no nasalized vowels in EP, i.e., vowels affected by the heterosyllabic nasal consonant, as in d[õ]no in BP, but d[o]no in EP (“owner”). There are three hypotheses regarding nasal vowels phonological interpretation:

- (i) Vowel nasality is assimilated from a nasal consonant in coda, either by the archiphoneme (BARBOSA, 1965), by transformational rules (MATEUS, 1975; ANDRADE, 1977), or by a C [+nasal] that overlaps [-vocalic, +sonorant] (WETZELS, 1997);
- (ii) a nasal autosegment is associated with the nucleus constituent (ANDRADE, 1994); and
- (iii) the [nasal] feature is lexically associated with the vocalic segment (FREITAS, 1997).

Hypothesis (iii) is the one assumed by Costa and Freitas (2001), as it agrees with the existence of phonological nasal vowels and lexicalizes them in EP, which, according to the authors, is consistent with their distinctive nature. To confirm or not this hypothesis, they analyzed and described acquisition data.

The authors observed that 22% of the target words that made up the database had nasal vowels. So, we can consider that children select and use nasal vowels from the beginning of phonological acquisition. Therefore, this structure is produced in the only pattern available for that age group, i.e., V and not VC, as expected in the biphonemic hypothesis. However, these segments are not fully stabilized at the beginning of the acquisition process, and many of them are produced as oral, as *dente* – /'dēti/ (“tooth”), which is produced as [ˈtethi] by Luís (1;11.20). The same strategy is used to produce nasal diphthongs, as in *mão* – /'mãõ/ (“hand”), which Inês (1;3.6) produces as [ˈma]. The use of nasal vowels and diphthongs stabilizes later, at the age of 2;11.2 when Luís, for example, started producing the word *branca* (“white”) as [ˈbrẽka] and the word *mãe* (“mother”) as [ˈmẽj] or [ˈmẽ], both with a nasal vowel. The data indicated that children have the ability to articulate the nasal gesture from a very young age, but its production is stabilized only later.

The most common error the authors observed in the child's productions is the replacement of nasal vowels by oral vowels. Nonetheless, when nasality is produced, it is associated, in a specific way, to the target-vocalic segment. In other words, no other vowel is nasalized. For the authors, this fact corroborates the lexical nature of the vowel and weakens the hypothesis of nasality representation as a floating autosegment, as advocated by Andrade (1994); if it were a floating autosegment, nasality would be associated with other vowels in the word, which does not occur in children's speech. According to Costa and Freitas (2001), such a pattern is found, for example, in the acquisition of primary stress, which also involves the process with an autosegment. In this case, stress is assigned to other vowels in the word. Thus, "it is verified that prosodic stress and vowel nasality do not present the same behavior, which may argue against the autosegmental nature of nasality" (COSTA; FREITAS, 2001, p. 98, our translation). For the authors, another argument that contradicts the hypothesis of nasality as an autosegment is that, unlike in BP, vowels are not nasalized by the following consonant in EP, as in *cana* (“cane”). Thus, nasality spreading from the consonant to the preceding vowel does not happen in EP.

The effectiveness of the system is another point mentioned to support the monophonemic hypothesis. Hypothesis (i), concerning the nasality of a vowel assimilated by a consonant in coda, deals with two levels of representation: a rhyme level and a segmental level; hypothesis (ii), concerning a

nasal autosegment associated with a constituent, also deals with two representational levels: the segmental and the autosegmental; hypothesis (iii), with which they agree, involves one level, the segmental, thus reducing the number of operations in the processing of nasal vowels and, consequently, in their representation.

However, the authors claim it does not seem possible to state, based on the analysis of the data, which of the two proposals EP nasality is more aligned with: a) an autosegmental proposal – in which a nasal autosegment is associated with the rhyme – or b) an analysis that holds that the [nasal] feature is lexically associated with vowels.

In a study on writing acquisition, Ávila (2019) also brings reflections about the phonological representation of nasal vowels. The author analyzed data from Brazilian, Mozambican and Portuguese children in order to investigate the graphic representation of post-vocalic nasality. She categorized the errors into two types: Phonological, related to spellings that express some representational aspect, such as the omission of the nasal grapheme (*mandou* spelled as *madou*); and Orthographic, which are the errors related to the spelling rules of a given language, such as the replacement of the consonants <n> and <m> (*canpo* instead of *campo*). The data were obtained through spontaneous texts produced by children from grades 1–7 of elementary school in public schools.

According to the author, the types of spellings found pointed to a monophonemic representation of nasal vowels. The most frequent error was the omission of the nasal by deleting the nasal consonant (44.4% in BP; 66.6% in Mozambican Portuguese; and 64.5% in EP). For Brazilian children, the omission occurred especially in word medial position, as observed by other authors, such as Abaurre [1988] (2011), Miranda (2009), and Rodrigues and Lourenço-Gomes (2018). Portuguese children had greater difficulty with the spelling of nasal vowels in word final position. Thus, according to Abaurre [1988] (2018, p. 186, our translation), "when children come into contact with writing, they are still operating with abstract phonological representations that contain oral vowels and intrinsically nasal vowels". Thus, according to Ávila (2019), the sequence proposed by the biphonemic strand – i.e. vowel + nasal consonant – is counterintuitive for these children. Therefore, in agreement with Abaurre [1988] (2011) and Miranda (2009, 2011), Ávila postulates that the phonological representation of children's nasal vowels is monophonemic, becoming biphonemic as a result of the literacy process.

In a more recent study, Marques and Scarborough (2020) also share the monophonemic conception for nasal vowels in Portuguese. Based on vocalic nasality perception tests, they investigated how 43 BP listeners perceive nasal vowels compared to their oral counterparts. To do so, they manipulated acoustic data (20 paroxytone and disyllabic words and pseudowords recorded by native speakers of BP), removing and including the nasal vowel murmur in order to verify whether this manipulation would interfere with listeners' perception. If the nasal vowel murmur interfered, listeners would perceive an oral vowel when the murmur was removed, attributing nasality essentially to the nasal consonant element. If it did not interfere, the vowel would continue to be perceived as nasal in the absence of the murmur. If nasality were associated with the external element, it would be evidence for the biphonemic status, i.e., the coarticulatory nasality. If this association did not occur, the results would be in favor of the monophonemic status. It should be noted, however, that the soft palate is lowered in advance, so that nasal formants are often found in the consonant before the nasal vowel (MORAES, 2013; MENDONÇA; SEARA, 2015; MENDONÇA, 2017), which also occurs in French (MONTAGU, 2007). Thus, a nasal vowel without the murmur would hardly be perceived as an oral vowel. The results of the study, which included 2579 responses, showed that the absence of the murmur does not prevent the perception of nasality. Therefore, it is inherent to the vowel. Only 5% of the participants said that the vowel with the murmur was more nasal. The murmur then would be part of the vowel element, not a consonant, in line with the monophonemic status of nasality.

As mentioned earlier, the number of studies supporting the existence of full nasal vowels in Portuguese, as well as in French, is smaller when compared to the biphonemic (/Vo+Cn/), which also accounts for a reduced number of arguments in support of the hypothesis. Because it has fewer supporters and less "theoretical strength", it would be of utmost importance to conduct research that seeks to prove the phonological existence of vocalic nasality in Portuguese through experiments and methodological advances, as Marques and Scarborough (2020) did. The following section discusses the biphonemic conception (V+ṽ) of nasality, as advocated by Parkinson (1983) and Pimenta (2019).

#### 4 The (VV) biphonemic status

For Parkinson (1983), the EP nasal vowels and diphthongs have a biphonemic status; consisting, however, of an oral and a nasal vowel, i.e., VV.

According to the author, nasal vowels are true diphthongs, which constitute open syllables. Oral diphthongs (*peito* (“breast”)), nasal monophthongs (*fã* (“fan”)), and nasal diphthongs (*pão* (“bread”)) derive from the same phonological structure – i.e., V+V in an open syllable – and thus have a complex syllabic nucleus. The difference lies in the quality of the second segment that integrated this structure, not in the quantity of these elements.

In oral diphthongs, the second element is oral; in monophthongs and nasal diphthongs, the second element is always nasal. Although both the VN and VV analyses consider that the nasality of diphthongs and monophthongs is in the final part of the syllable, the former considers that the nasality strength of a nasal vowel is inversely proportional to the prominence of the nasal consonant, that is, the nasality level of the vowel depends on the deletion level of the final nasal consonant. However, the latter predicts that every “consonantal transition will be the conversion of the second part of the underlying diphthong to a more consonantal articulation, which automatically reduces the length of the nasal portion of the nucleus” (PARKINSON, 1983, p. 160, our translation).

Based on this interpretation regarding the phonological constitution of nasal vowels, the author presents some arguments to defend his biphonemic hypothesis (V+  $\tilde{v}$ ):

(i) It is possible to predict through the representation / $v\tilde{v}$ / that the nasality of a nasal monophthong or diphthong is located in the last portion of the syllabic nucleus, as already corroborated by instrumental phonetics;

(ii) the VV analysis makes more clearly explicit the relationship between certain monophthongs and their derived diphthongs in word-final position, as in *bem* > *běj* (“good”). Instead of introducing a glide, only one rule is applied, which changes the quality of the second vocalic element; and

(iii) the phonological status of nasal vowels, while VV simplifies the process of denasalization of unstressed final nasal vowels, as in [‘ $\text{ɔrf}\tilde{\text{e}}$ ] and [‘ $\text{ɔrfa}$ ], and the monothonging and denalization of unstressed nasal diphthongs, as in [‘ $\text{om}\tilde{\text{e}}\text{j}$ ] and [‘ $\text{omi}$ ]. What occurs, according to the author, is the deletion of the second vocalic element, precisely the one that carries the nasality.

Moreover, to support his claim that nasal vowels behave as diphthongs, the author highlights the fact that resyllabification does not occur in the presence of a diphthong or of a nasal vowel (oral vowel + nasal vowel). When produced, *sal e pimenta* (“salt and pepper”) receives the following syllable division: [‘sa.li.pi.mẽ.tɐ]. As can be observed, the final [l] in *sal* (“salt”) goes to the next syllable, which does not occur if instead there were a diphthong or a nasal vowel – as in *comeu e bebeu* [ku.’meu.i.be.beu] (“you ate and drank”), or in *lã azul* [lɛ̃.e.’zul] (“blue wool”). According to Parkinson (1983), the resyllabication pattern of the external sandhi process – without the appearance of a nasal consonant in *onset*, both when diphthongs or nasal vowels are present in the final syllable of the first word—is another similarity between the phonological behavior of nasal vowels and oral diphthongs. Note, however, that this same argument is used by advocates of the /VN/ biphonemic hypothesis. Where is the difference?

According to the author, it is necessary to recognize the various levels of phonological structure, such as the archiphonemic, the phonemic, and the phonetic levels. Finally, he highlights the fact that for almost a century, phoneticians have addressed the phonological status of nasal vowels based on the existence or absence of a post-vocalic nasal consonant. According to him, many phoneticians detected post-vocalic nasal segments (VIANA, 1892, 1903; NOBILING, 1903; GUIMARÃES, 1927; STREVENS, 1954; HEAD, 1964; ALMEIDA, 1976) and represented them as consonants because “that is all they expected to find” (PARKINSON, 1983, p. 175). For the author, therefore, non-consonantal transitions are identified if the data are analyzed with a more refined transcription system and with a larger set of options being considered.

Pimenta (2019) shares the same view as Parkinson (1983) regarding the status of these segments, although she follows different paths to defend it. For the author, nasal vowels and oral diphthongs share some properties: They behave as heavy rhymes for syllable weight attribution; they allow the suffixation of the /-s/ morpheme without the occurrence of epenthesis; they do not undergo resyllabification in the context of external sandhi process; they do not undergo vocalic reductions in unstressed position. In addition to these similarities, the author highlights the similarity between the duration of nasal vowels and oral diphthongs.

She compared the duration of oral vowels (V), nasal vowels (NV) and oral diphthongs (VG) in two stressed contexts, word final ( \_#) and before a heterosyllabic consonant ( \_C). In word final context, the tokens were monosyllables and oxytones, and in non-final position they were disyllables and paroxytones. The carrier sentence (*Palavra. Temos (som vocálico) em (palavra)*) ("Target word). We have (vowel sound) in (target word)") was used. For example, *Caça. Temos A em caça* ("Hunt. We have U in hunt"). Six native speakers of EP read the sentences and produced a total of 3240 tokens.

The results showed that NV and VG present the same duration, being greater than that of the oral vowels, in the two controlled contexts. In the non-final context, the nasal vowels were even longer than the oral diphthongs. She also observed that the combination V+C (oral vowel and consonant) was shorter than VG+C (oral diphthong and consonant) and NV+C (nasal vowel and consonant). Therefore, the author claims that when nasality is added, there seems to be some compensation between the duration of the nucleus and the duration of the following consonant. Statistical tests did not prove this in either the fricative or plosive context. An ANOVA showed that the phonological category plays an important role in this analysis.

According to the author, the results prove that nasal vowels have a bipositional structure, just like diphthongs, and that the nasal element occupies the second vocalic position of a branched nucleus. The nasal element has no position by itself, which is why it occupies neighboring positions in search of stability (PIMENTA, 2019).

Having presented the three major conceptions regarding the phonological nature of vocalic nasality in Portuguese – the latter still not widespread among scholars – and based on relevant works in the field, we present the conclusion of this study.

### **Final considerations**

The present study sought to review the main studies in the literature that defend different conceptions about the phonological nature of nasal vowels in Portuguese. We know that nasal vowels are distinctive in Portuguese; the old technique of commutation makes this clear. The major question concerns the nature of the phonological representation, whether it is monophonemic, that is, a full nasal

vowel, or biphonemic, with the presence of an oral vowel followed by a nasal consonant or the presence of an oral vowel followed by a nasal vowel, thus forming a diphthong.

The (BV) biphonemic conception of Portuguese vocalic nasality, defended by most of the work on the topic, seeks to prove its proposition through structural aspects of the Portuguese language and comparisons with French, a language in which the existence of full nasal vowels is accepted. For defending this hypothesis, speaker's feelings regarding nasality, processes of crasis, sandhi, rhotic distribution in nasal context, prefixal derivation, among other arguments, were considered and used. Several of these aspects are observed in French, as already pointed out by other authors, such as Tláskal (1980). Even in Portuguese we find counter-arguments, as highlighted in Section 1 of this manuscript.

Contemporary scholars have drawn attention to the arguments for the biphonemic hypothesis in order to strengthen the monophonemic hypothesis, but the most convincing arguments are few and far between. The number of studies that support the phonological representation of full nasal vowels in Portuguese is still relatively small, and this scarcity of studies and, consequently, of arguments, weakens this position. The same occurs for the (VV) biphonemic hypothesis. Nevertheless, these last two proposals have considered experimental data more expressively, which, in our view, moves towards what we expect from the field; that is, an integration between phonetics and phonology.

The aim of this paper was to compile the three main proposals and their arguments, contributing to the construction of a theoretical framework for future work on the subject. There is no doubt that more studies are needed to answer the question: Are the Portuguese nasal vowels mono or biphonemic? There are several studies that deal with Portuguese nasality from different perspectives – acoustic, articulatory, perceptual, aerodynamic – but they do not present a position in relation to the phonological status of vowel nasality in Portuguese (SOUSA, 1994; SEARA, 2000; JESUS, 2002; MEDEIROS, 2007; SOUZA; PACHECO, 2012; SANTOS, 2013; BARBOSA, 1965; MADUREIRA, 2015; TEIXEIRA-CORREA; FERREIRA-GONÇALVES; BRUM-DE-PAULA, 2017).

Thus, "when someone asks if there are phonological nasal vowels in Portuguese, the answer is: It depends. It depends on the theoretical framework used to analyze them" (COUTO, 1997, p. 75, our translation). The description of these segments, especially through technologies still little used in



laboratories in Brazil, such as ultrasound and aerodynamics, can bring significant contributions to the discussion presented here.

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Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing. SEARA, Izabel Christine.

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