Notes on the historical palatalization and assimilation of [j] in the nasal alveolar consonant [n] in Spanish

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ABSTRACT

In this paper we want show that the historical palatalization of [n] and the assimilation of [j] to form a nasal palatal sound [ɲ] is nowadays incomplete. The results of our experiments seem to show that there are still some remainings of the semivocalic sound [j]. We have observed that a little increase of the first and the second formants and a progressive growth of the global intensity appear at the end of the nasal structure in the realization of [ɲ]. We have also appreciated that if the nasal formant (F2a) exists, it disappears in the beginning of the rising of the second formant. In the cases in which it does not disappear, it also undergoes a frequency increase.

1. INTRODUCTION

Historically, [ɲ]came from the palatalization of an alveolar nasal in contact with a palatal vocalic sound [j]. In this paper we want to show that in [ɲ] a remaining of this original vocalic sound appears, due to an incomplete assimilation showed by: a) the appearance of a formant frame similar to the structure of a palatal vocalic sound, b) an amplification of the global intensity and c) the reinforcing of the third formant, which is very weak in the nasal stage. This vocalic remaining is produced between the opening of the vocal airstream and the closing of the velopharingeal port. This second stage is responsible for the reduction of the intensity in the second formant of the yod.

The Spanish traditional acoustic view of the sound that we want to analise in this paper is that it should be regarded as a single sound..

In this way, Quilis [1] defines [ɲ] as a prepalatal sound in which the velopharyngeal port is opened and with a strong positive transitions [2]. Following the same direction, Introno, Teso & Weston [3] and Martínez Celdrán [4] in more recent works define [ɲ] as a single sound.

On the other hand, Navarro Tomas [5] believes that the [ɲ] has not got the bifonation stage and criticizes the teachers of Spanish as a second language because they teach this sound as "ny". However, he states that the sound [ɲ] has similar features to a cluster formed by a nasal sound and a [d͡ʝ] In the last sound of this cluster, the velopharingeal port is opened.

Massone [6] proposes a different model. He considers this sound as consistent of two stages: a) a stop which constitutes the nasal murmur and b) a short palatal constriction [j]. We will take this model as the starting point of our analysis. This researcher sees this palatal element as an important cue for the recognition of [ɲ] [7].

Our claim is that the partial assimilation of the yod produces a bifonation in which we can clearly see a mark of the historical vocalic palatal sound following the nasal stage.

In our experiment we have obtained 243 cases from 6 male individuals. Their mother tongue is Spanish and they come from the North of Spain (Asturias, Cantabria and the Basque Country).

All of them have read sentences containing the sound [ɲ] in sequences CV. This sequences are accented and unaccentec syllables and situated at the beginning, in the middle and at the end of the melodic group.

We have recorded these sentences using the CSL 4300B hardware with an unidirectional microphone and in a semi-isolated situation. The sampling frequency we have used is 11025Hz. and the acoustic analysis was made with the Praat Program and CSL 4300B-multispeech.

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2. RESULTS

2.1 Formants:

Taking a quick look at the spectrogram of the palatal consonant [ɲ], we clearly appreciate some interesting movements at the end of the nasal structure. These movements are elevations in the three first formants –as we can see in figure 1-, excluding the nasal formant (1400-1700Hz). This formant usually disappears when these three formants increase.

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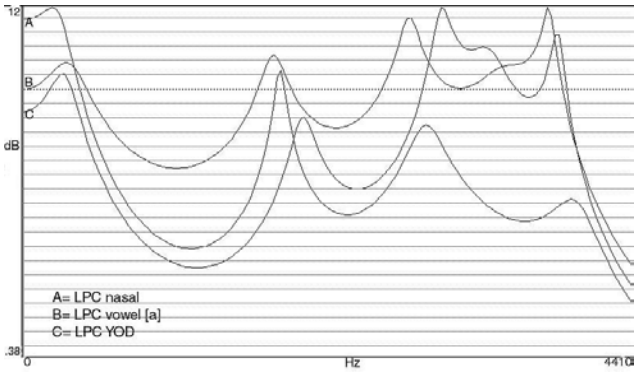

Figure 1: LPC of the nasal period, remaining yod and consiguient vowel [a]

The statistical results show that this movement from the nasal structure to the structure of a strong nasalized yod is constant in the cases we have analysed. This is valid not only in stressed and unstressed syllables, but also in sequences with different vowels:

	Mean (Hz)	Std. Dev.
F1 nasal	288,212642	39,146288
F2 nasal	1979,346572	192,651751
F3 nasal	3047,374216	508,856254
F1 Yod	339,477446	63,552533
F2 Yod	2158,988930	172,957899
F3 Yod	2913,589573	321,543053

Table 1: Mean of nasal and yod formants

As we can see in Table 1 the difference between them is very significant. In this figures we have observed a correlative relationship: the higher the value for each formant of the nasal stage, the bigger elevation of the formants in the yod, as the Pearson Coefficient shows:

F1-F1: ,642; sig. ,000

F2-F2: ,628; sig. ,000

F3-F3: ,461; sig. ,000

This correspondence can be seen in figure 2-4 :

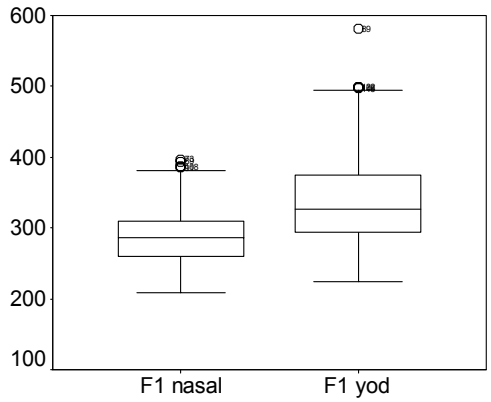

Figure 2: boxplot of the F1 of the nasal and yod

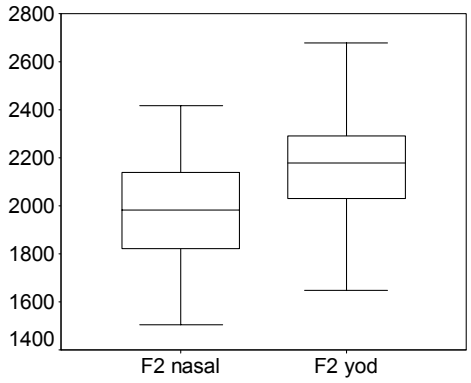

Figure 3: boxplots of F2 of nasal and yod

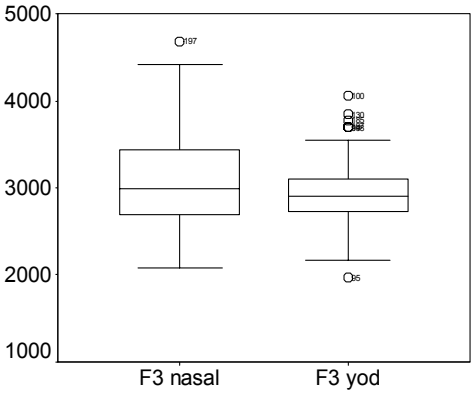

Figure 4: boxplots of F3 of nasal and yod

The F1 leaves the low frequencies which determined the nasal sounds, and the F2 undergoes an rise of 150-200 Hz. independently of the following vowel.

According to the results, we believe that the presence of the remaining of yod is configured over the nasal structure of formants.

2.2 Global intensity:

Other important variable in our experiment has been the global intensity variation along the nasal. We can clearly see that there is an increase of about 2-5 dB in the intensity of the yod period. This growth belongs to the moment in which the vocal tract is opened, and the velopharingeal port starts its closing. There is a positive correlation between the intensities with a Pearson Correlation of ,995 and a sig. ,000.

2.3 Intensity of formants:

We also have observed a great decrease in the intensity of the second formant of the yod. In our opinion, this fact is due to the co-occurrence of the nasal murmur and the remaining of the historical yod. This co-occurrence is due to a considerable opening of the velopharingeal port. We have obtained a mean of 14,3955dB in the stressed syllable and of 16,0568dB in the unestressed one with a std. dev. of 5,1967 and 4,4530 for each case.

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The vocalic nature of the yod, the opening of the vocal tract and the partial closure of the velopharingeal port cause an increase in the intensity of the third formant, as we can see in table 2.

Syllable	Melodic position	Mean (dB)	Std. Dev.
Stressed	*Beginning*	20,0433	5,2318
	Middle	18,0737	5,8779
	End	15,0661	4,6534
Unstressed	*Beginning*	16,6188	6,8169
	Middle	17,9947	5,3759
	End	14,3766	5,9675

Table 2: intensity difference between the F3 of the nasal and the F3 of the bifonation stage

In this sense, the predominance of the nasal resonator silences high frecuencies. It also produces a reduction in the intensity of both second formants; that of the nasal and that of the remaining of the yod. The third formant grows with the dissapearance of the vocal constraint, although the second formant undergoes the decrease caused by the opening of the velopharingeal port.

2.4 Transitions:

The total length of the nasal, of the remaining of the yod and of the transitions is shown in table 3:

	Length (ms)	Std. Dev.
[ɲi]	93,9046	19,7889
[ɲe]	110,1136	21,5688
[ɲa]	129,5251	20,7664
[ɲo]	125,4968	23,3587
[ɲu]	134,2059	21,7960
Total	121,9012	24,1492

Table 3: Total length of nasal, yod and transition

As regards the transitions between the remaining of the yod and the following vowel, we can say that they are slow and dependent on the proximity of their respective formants.

Massone [6] reckons a transition of 94ms, but we appreciate important differences depending on the following vowel, as shown in Table 3. The coefficient of correlation of these variables is ,490, sig. ,000.

	Mean (ms)	Std. dev.
[ɲi]	30,23218228	13,29607082
[ɲe]	45,81464204	12,88148111
[ɲa]	63,72877578	13,29060229
[ɲo]	60,67204815	15,65663306
[ɲu]	69,11455202	20,28579185
Total	56,93914225	17,79321401

Table 4: length of transition to consiguient vowel

3. CONCLUSIONS

We can distinguish two stages in the continuum of the [ɲ]. The first one is a nasal palatal element with a high F2. The second stage is a remaining historical yod which is strongly nasalised. This second stage is produced due to the partial closing of the velopharingeal port and the opening in the vocal tract.

These two stages are shown by the following cues:

- Ascendent movement of the two first formants from the nasal to the remaining yod independently of the subsequent vowel.
- Obvious emergence of a third formant in the bifonation, with an approximate increase of 15-20 dB more than the third formant of the nasal period.
- The strong nasalization of the yod is shown by an important decrease in the intensity of the second formant. This is due to the opening of the velopharingeal port.
- Slow formant transitions from the nasalized yod to the following vowel. These transitions are quite similar to those dypthongs formed by a [j].

Finally, we could conclude that there is an incomplete assimilation of the historical vocalic palatal sound [j] in the nasal. This element has produced the palatalization of the nasal sound but it does not disappear completely. The influence of the nasal murmur can be seen in the strong nasalization of the remaining yod.

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