

# Nasometric values for European Portuguese: preliminary results

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## 0. Introduction

Resonance is one of the most prominent characteristics of human speech. Problems affecting nasal resonance are widely reported in speech pathologies, causing severe perturbations in subjects speech intelligibility.

Nasal resonance values can be obtained through different instrumental methods, however, the nasometer proved to be an indirect and objective assessment instrument which results have shown to have a high correlation with perceived nasality (Hardin et al. 1992, Hirschberg et al. 2005).

Normative nasalance scores have been already determined for several languages such as English (Seaver et al. 1991), French, Spanish (Nichols 1999), Puerto Rican Spanish (Anderson 1996), Finnish (Haapanen 1991), Dutch, Flemish (van Lierde et al. 2000) and Hungarian (Hirschberg et al. 2005). Some of the studies pointed to the existence of differences among different dialects, reinforcing the need to have nasalance norms established for each sample in every language. Our research main goal was to collect normative nasalance scores for European Portuguese language, in order to make possible an easy detection of nasal resonance problems in this language, either hiponasality or hipernasality.

## 1. Experiment

In European Portuguese:

- ✓ there are 3 nasal consonants and 5 nasal vowels
- ✓ usually, nasal consonants spread their nasal feature to the adjacent vowels nasalizing them

### Experimental material

We developed 2 tests: a **repetition syllable test** and a **text reading test**.

- ✓ 40 syllables distributed by 4 combinations:

- A. oral consonant – oral vowel (pa, ba...)
- B. oral consonant – nasal vowel (pã, bã...)
- C. nasal consonant – oral vowel (ma, ni...)
- D. nasal consonant – nasal vowel (mã, nhã...)

- ✓ 8 reading passages considering 2 basic different criteria:

- A. absence of nasal sounds
- B. saturation of nasal sounds (26 to 33% of nasal sounds).

### Subjects

25 adult (12 females) subjects EP native speakers, aged 19 to 27, with no history of otorhinolaryngological disorders, abnormal nasality or without common colds and nasal congestion participated in this preliminary study.

### Nasometry and the nasometer

We used the Kay Elemetrics Nasometer 6200-3 which is a computer-based system, where the oral and nasal acoustic energy components are captured by microphones mounted on each side of a separator plate, that is placed in the subject's upper lip for data collecting. This nasometer provides a nasalance score which corresponds to a ratio of nasal to nasal-plus oral acoustic energy, multiplied by 100.

The nasometer was calibrated before data collecting and the position of the headset was adjusted according to manufacturer's manual specifications in order to get reliable data.

## 4. References

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## Experimental procedure

The **syllable-repetition test** required participants to repeat a consonant-vowel syllable 6 to 10 times in two seconds.

The **text reading test** required the participants to read a small text with no hesitations or pauses.

## 2. Results

**Normal nasalance score for stimuli with no nasal segments is in average 10%**, both in syllable repetition and in text reading (see Table 1 and Table 2). Nasalance values different from zero in oral stimuli were also reported in studies from other languages (see Hirschberg et al. 2005 for a literature review).

Results of syllable types B and C are very near from each other, especially if we consider the high standard deviation values that both present. This may mean that nasal consonants and nasal vowels are quite similar in what acoustic energy is concerned.

**The highest nasalance score average was achieved in the syllable type D.** This value is higher than the ones for other languages with values ranging between 40% and 60%. However, not every other language has nasal vowels in its phonological system so when the values for nasals are shown they are considering only nasal consonants with oral vowels like our syllable-type C.

Nasalance scores for text reading saturated with nasals sounds are considerably lower than the ones registered in syllable repetition test and closer to scores from other languages.

Syllable - types	Average	SD
A – OO	10%	2.83
B – ON	69%	12.22
C – NO	65%	9.74
D – NN	77%	9.45

Table 1. Results of nasalance scores by Resonance Syllable type

Text Reading	Average	SD
No nasals	10%	3.15
Nasals saturation	44%	8.07

Table 2. Results of nasalance scores by Text Reading

Results of this experiment we acknowledge the existence of three levels of normal nasality in European Portuguese:

- **N0** corresponds to a level of nasality of 10% for oral stimuli (syllable and text);
- **N1** is the intermediate level of nasality - 40% - and corresponding to text reading saturated with nasals;
- **N2**, the highest level, corresponds to 70% of nasalance and characterizes the syllable-type D (nasal consonant and nasal vowel).

The difference between each level is of 30% starting from the lowest average nasalance score for oral stimuli.

## 3. Conclusions

This research provided the first global nasalance scores for European Portuguese in a syllable-repetition task and in a text reading task. Results revealed to be quite similar to values from other languages, especially in what oral stimuli are concerned.

Based on these results, we proposed the existence of **three levels of normal nasality for European Portuguese: N0, N1 and N2**.

Two forthcoming studies, one with 66 EP native children (aged 6 to 10) and the other with 30 females, will provide further evidence for this proposal.