THE PERCEPTION OF CONSONANTAL NASALITY IN ITALIAN: CONDITIONING FACTORS

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ABSTRACT
A test has been performed with natural and artificial sequences to check the actual role of vowels in the perception of the nasality feature of Italian consonants. The procedure and results are presented and discussed in the present paper.

0. FOREWORD
The Italian phonological system is traditionally said to have a series of nasal consonants but no nasal vowel. Vowels are only said to become nasalized for anticipatory coarticulation in $V-C_N$ or, more often, for carryover in C_N-V contexts. Such vocalic nasalization is given no phonological significance, nor has it ever been investigated whether it has any direct perceptual relevance for the recognition of the V-C or C-V sequence. In a previous research [1] some experiments were made with nasalized and non-nasalized (final) vowels in Italian minimal pairs such as <u>vini</u> ~ <u>vidi</u>, <u>cane</u> ~ <u>cade</u>, <u>alma</u> ~ <u>alba</u>, etc. Such sequences showed a regular nasalization of the final vowel if preceded by a nasal consonant (C_N-V > C_N-V_N), and no nasalization in the opposite case

(C_O-V > C_O-V_O). The experiment consisted in an artificial inversion of the final vowels, so to obtain such final sequences as C_N-V_O and C_O-V_N.
The answers given by a group of listeners showed that their perception of the nasality ~ non-nasality feature in the consonants ([n]~[d], [m]~[b]) was very strongly affected by the presence ~ absence of the same feature in the following vowel. This means that in case of inconsistency between the nasality feature present in the consonant and the one present in the vowel, it was surprisingly the latter which used to prevail: so both the [α nasal] vowel and the [$-\alpha$ nasal] consonant were heard as [α nasal], with a somehow asymmetrical behavior, as the effect was general for α = + and apparently underwent some restrictions for α = -.
On the present occasion I will present and describe the results of a new test realized with approximately the same technique as the previous one on a much larger set of Italian minimal pairs, each containing the opposition between an oral and a nasal homorganic consonant, in order to check the results previous-

ly obtained and to relate them to some variables.

1. MATERIALS AND METHODS

The words for the test have been selected according to the following criteria:

a) preceding context: an Italian consonant in pre-final position in a bi- or polysyllabic word can be either preceded by one of the seven vowels [i,e,ɛ,a, ,o,u] or by one of the consonants [z,l,r,m,n]; the vowels [e~ɛ] and [o~] have not been used here because of the very fluctuating use Italian speakers make of such oppositions; with [z] no minimal pair was found; as to nasals, only the hom-organic one is accepted, so before alveolars only [n] is used, and only [m] before bilabials; the actual set of preceding contexts used was [a-,i-, u-,l-,r-,N-];

b) following context: in final (unstressed) position only four vowels can be found [-a,-e,-i,-o] as [u] is practically absent in that position and the oppositions [e~ɛ] and [o~] are neutralized;

c) place of articulation: only two pairs of (voiced) oral vs. nasal consonants exist in Italian [b~m] and [d~n], as the pair [g~n] is neither phonological nor can it appear in the examined position.

The product of 6 preceding contexts * 4 following contexts * 2 places of articulation makes 48 potential pairs of sequences. A careful examination of the Italian lexicon showed that only 26 of them are actually employed (not taking into account rare or obsolete words). Here is the list of the theoretical contexts. Those employed in the present research are underlined; only the oral sequences are listed, not their nasal counterparts, which can be easily obtained substituting -n- for -d- and -m- for -b-:

ada	ade	adi	ado
<u>ida</u>	<u>ide</u>	<u>idi</u>	<u>ido</u>
<u>uda</u>	<u>ude</u>	<u>udi</u>	<u>udo</u>
lda	<u>lde</u>	ldi	ldo
<u>rda</u>	rde	<u>rdi</u>	<u>rdo</u>
<u>nda</u>	nde	<u>ndi</u>	<u>ndo</u>

aba	abe	abi	abo
<u>iba</u>	ibe	ibi	ibo
<u>uba</u>	ube	ubi	ubo
<u>lba</u>	<u>lbe</u>	<u>lbi</u>	lbo
<u>rba</u>	<u>rbe</u>	<u>rbi</u>	<u>rbo</u>
<u>mba</u>	mbe	<u>mbi</u>	mbo

A native male Italian speaker of 29 years old uttered the words in our laboratory. The words were recorded on a tape. The splicing of the final vowels from the rest of the word was carried out on the basis of the observation of both the oscillograms and spectrograms of the natural signals, along the conventional segment boarders. The operation of inversion between the final vowels of each pair of words was effected by means of a DSP-Sonagraph 5500 "gating \editing" procedure (such device allows to choose the "cutting" point with an approximation of ±3 ms).

A group of 23 Italian students of foreign languages and literatures between 19 and 27 years old was then asked to listen to both the natural and artificial sequences and to give their judgment about them. The test was organized as follows: each of the 52 words making up the 26 pairs was presented aurally (in headphones) in its natural shape and at the same time

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the subjects could read it on a special form prepared for them; the natural stimulus was then followed by two artificial sequences built up with the phonic material of the corresponding minimal pair (e. g. the natural word strada was followed by an artificial stimulus made up with strad- plus the final -a from strana and by one made up with stran- and -a from strada); the order of the natural stimuli was completely random, and so was the order of the two artificial stimuli following the natural one; the listeners were asked to decide which of the two artificial stimuli heard resembled best the natural stimulus previously heard and read.

2. RESULTS AND DISCUSSION
Following strictly the phonological models of Italian, one would expect the substitution of a final nasalized vowel with a non-nasalized one and viceversa to have no effect on the perception of the sequence, as the nasality of the consonant, which is considered the only pertinent manifestation of nasality, is perfectly preserved. So, starting from the natural stimulus strada, one can consider the artificial $strad+V_N$ to be phonologically the "same" as the natural sequence, and $stran+V_O$ a "different" sequence. So, all answers to the test can be classified as "phonological" (+phon) if the "same" stimulus is indicated to resemble best the natural one, and "anti-phonological" (-phon) if the "different" stimulus is chosen.

Globally, the answers given by the students are as follows:

answers		
type	number	percentage
+phon	314	26.2%
-phon	882	73.8%

The results will now be presented and examined according to the variables above listed. A general discussion will follow.

a) Preceding context

answers			
V-	type	number	percent.
a-	+phon	47	25.5%
	-phon	137	74.5%
i-	+phon	57	24.8%
	-phon	173	75.2%
u-	+phon	83	45.1%
	-phon	101	54.9%

C-	type	number	percent.
l-	+phon	74	40.2%
	-phon	110	59.1%
r-	+phon	36	19.6%
	-phon	148	80.4%
N-	+phon	17	7.4%
	-phon	213	92.6%

As can be seen from the above tables, the number of -phon answers always exceeds the +phon. The most favorable contexts for such effect are the presence of a nasal [N-] and an alveolar vibrant [r-]. Also with [a-] and [i-] the results are pretty good in the direction of an anti-phonological behavior, while after [u-] and [l-] the answers approximate a random distribution of 50%-50%.
b) Following context

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	answers		
-V	type	number	percent.
-a	+phon	94	25.5%
	-phon	274	74.5%
-e	+phon	37	13.4%
	-phon	239	86.6%
-i	+phon	158	49.1%
	-phon	164	50.9%
-o	+phon	25	10.9%
	-phon	205	89.1%

In this case, too, some contexts seem to be very favorable to a -phon behavior, such as [-o], [-e] and, to a lesser extent, [-a], and one context, [-i], with a random distribution of the answers.

c)Place of articulation

	answers		
place	type	numb.	percent
alv.	+phon	120	17.4%
	-phon	570	82.6%
bilab	+phon	194	38.2%
	-phon	312	61.8%

The difference is rather large in favour of the alveolar place of articulation, which shows a high percentage of -phon answers; with bilabials the effect is smaller, though still exceeding a casual distribution enough to be considered meaningful.

d)Direction of the effect

	. answers		
-C-	type	numb.	percent
oral	+phon	174	29.1%
	-phon	424	70.9%
nasal	+phon	140	23.4%
	-phon	458	76.6%

As indicated above, the results of a previous test had shown an asymmetrical perceptual effect of the inversion of the vowels, so that the sequence C_N-V_O was generally perceived as C_O-V_O, while the perception of C_O-V_N as C_N-V_N was also frequent but not to the same extent. In the present test there is still a slightly higher number of -phon answers for nasal than for oral consonants, but the difference is too little to be meaningful.

The results, on the whole, witness a very strong effect of the vowel's nasality feature on the perception of the preceding consonant. Even the lowest percentages obtained, which still exceed 50%, show that in case of inconsistency between the nasality feature in the consonant and in the vowel, the first does not prevail automatically, as phonologists seem to presume, when they exclude that the nasalization of vowels has any pertinence in Italian. In case of random distribution of the answers, the feature of nasality can be said to have an equal weight in consonants as in vowels. But the general result of the test, and the particular result in most contexts, is that the weight of nasality in consonants and in vowels is not the same, and that the feature of nasality seems to be much more important for vowels than for consonants in Italian.

3.REFERENCE

[1] GIANNINI A., MATURI P., PETTORINO M., "Il ruolo della nasalità nella fonologia dell'italiano", in FUSETTI M.(ed.), Atti del XVIII Convegno Nazionale dell'Associazione Italiana di Acustica, L'Aquila 18-20 aprile 1990, pp.191-6.