AN APPROACH OF THE CATALAN PALATALS DISCRIMINATION BASED ON DURATIONAL PATTERNS OF SPECTRAL EVOLUTION

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ABSTRACT

Catalan has been studied by several authors, who gave phonologic as well as phonetic descriptions of the language. In most studies, authors have nevertheless focussed on categories of sounds, considered each in turn, rather than on possible associations of sounds. Implementations of this knowing may therefore raise problems, since acoustical patterns of dynamical evolution are not well known. The paper addresses the particular case of the [ʎ]-[lj] and [ɲ]-[nj] acoustical differences. The data show that the differences to be found are mainly related to reorganisations of the time function.

1. INTRODUCTION

Recent progresses in advanced signal processing have stressed the idea that in many areas of speech R/D, the most important remaining problems are mostly related with the lack of exhaustive descriptions of phenomena to be taken into account, rather than with the development of really new techniques. Many languages have not been described in all respects, so that their technological processing, either for synthesis- or analysis might be hampered. Some aspects of Catalan still remain to be studied for that purpose.

This is particularly the case of the palatal sounds and associations of sounds, which constitute the subject of this paper. Catalan has been studied by several authors, who gave phonologic (1, 10) as well as phonetic (6, 7) descriptions of the language. In most studies, authors have nevertheless focussed on *sounds*, considered each in turn, rather than on possible *associations* of sounds. Regarding the palatals of Catalan, this might be the source of some discrimination problems: Catalan has three palatal phonemes, i.e., /ɲ/ (as in *manya* [maɲa]), /ʎ/ (as in *palla* [paʎa]), and /j/ (as in *iaia* [jajə]). The first two differ from /n/ and /l/, respectively, by the unique trait of palatality. Actualizations of phonemes /ɲ/ and /ʎ/ could therefore easily be confused with actualizations of the corresponding associations of phonemes /nj/ (as in *unio* [unjo]) and /lj/ (as in caliuejar [kəljuəʒa]), respectively (2). This question does not make sense in the field of phonology because it requires merging different conceptual categories (i.e., phonemes and phonemes sequences). Its importance is therefore mainly stressed by the pragmatic requirements of implementation. This is probably the reason why it has received few attention up to now.

2. EXPERIMENTAL SETTING

2.1. Corpus

In this paper, we compare actualizations of Catalan palatal phonemes and of the corresponding two-phonemes sequences. The target structures have been placed in non-sense words, inserted in bearing sentences. They are presented to the subjects in orthographic form, which enables unambiguous decision about the expected unit(s): Catalan orthographic code associates the letters *ll* with /ʎ/, *li* with /lj/, *ny* with /ɲ/ and *ni* with /nj/.

1.Target structures [ɲa] and [nja]
nonsense word "banyà" [bəɲa]
nonsense word "banià" [bənja]
inserted in bearing sentences:
"Banià" no ès una paraula del lèxic tauri
"Banyà" sembla una paraula del lèxic tauri

2.Target structures [ʎa] and [lja]
nonsense word "rollà" [ruʎa]
nonsense word "rolià" [rulja]
inserted in bearing sentences:
Rollà ès el nou professor del Departament
Rolià serà el nou jugador del Barça

2.2. Subjects

Five catalan native male subjects produce the corpus. They were all from the Barcelona area and were living there when they were selected. They were all 30-year old and academics. Their mother tongue was central Catalan.

2.3. Recordings

The recordings took place in usual laboratory conditions at the Autonomous University of Barcelona with a high-quality recording equipment.

2.4. Analyses

The utterances of the corpus have been analyzed by means of time-normalized LPC-based formants tracks (for the lateral sounds), and FFT-based spectrograms (for the nasal sounds).

3. RESULTS

3.1. Target structures [ɲa] and [nja]

All the realisations of the [nj] sequences reveal the existence of a nasal segment, directly followed by a stable formantic structure with the frequential characteristics of an [i]. This segment is immediately followed by a transition towards the frequential values of the following vowell ([a]). In the case of the nasal palatal, the stable portion disappears and the formantic transition begins immediately after the end of the nasal segment. As can bee seen in table 1, the [ə] segment duration in the target structures[ɲa] is systematically smaller than in the [nj] sequences.The nasal segment is longer in the case of the nasal palatal . The total duration of the production is systematically longer in the case of the [nj] sequences, even if this superiority is sometime thin (i.e., speaker 3).

Speaker		*nasal*	*stable*	*trans.*	*end*
1.	*[nj]*	*88*	*170*	*256*	*514*
	[ɲ]	*93*	*-*	*204*	*430*
2.	*[nj]*	*88*	*139*	*237*	*464*
	[ɲ]	*89*	*-*	*206*	*364*
3.	*[nj]*	*62*	*123*	*200*	*400*
	[ɲ]	*87*	*-*	*187*	*383*
	[ɲ]	*90*	*-*	*178*	*357*
5.	*[nj]*	*87*	*175*	*267*	*528*
	[ɲ]	*96*	*-*	*224*	*366*

Table 1: durational patterns (in ms) of the Catalan natives'productions of the target structures [ɲ] and [nj] (time clapsed since the beginning of [ə] to the beginning of the nasal, the stable portion, the transition and the end of the production).

An illustration of the phenomena analyzed in table 1 is presented in figure 1.

3.2.Target structures [ʎa] and [lja]

Concerning the productions of the [lj] sequences, systematically higher frequential values can be observed for the second formant than in the case of the lateral palatal realisations (cf. table 2). Excepted for subject 3, ascending movement of the transition is by another way retarded in comparison with the [ʎ] one, that begins at the initial of the word. The ascending movement of the second formant is curvilinear in the case of the [ʎ] productions; some interruptions of the continuity and a flat portion can be observed in the [lj] realisations. The falling movement of the second formant appears quite earlier in the case of [ʎ] than in the case of [lj]. An illustration of these phenomena is given in figure 2.

Speaker		*rel. duration*	*frequency (Hz)*
1.	*[lj]*	*.54*	*2315*
	[ʎ]	*.49*	*2014*
2.	*[lj]*	*.73*	*2328*
	[ʎ]	*.52*	*2145*
3.	*[lj]*	*.51*	*1925*
	[ʎ]	*.51*	*1792*
4.	*[lj]*	*.72*	*2045*
	[ʎ]	*.50*	*1942*
5.	*[lj]*	***.74***	***2104***
	[ʎ]	***.71***	***1864***

Table 2: durational patterns (relative duration from the beginning of the nonsense word) and frequency values (in Hz) of the second formant's top for the the Catalan natives'productions of the target structures [ʎ] and [lj]

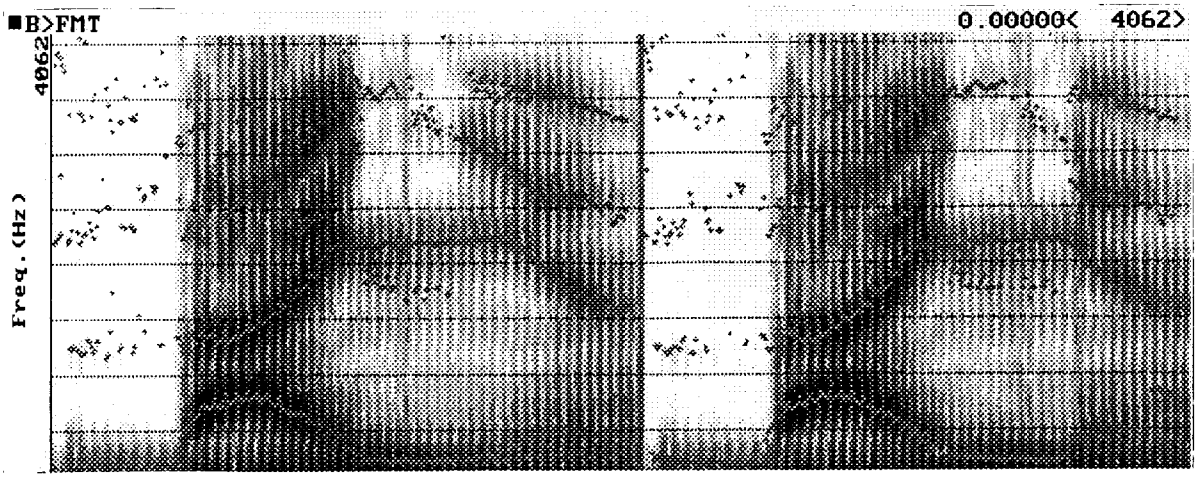

Figure 1: examples of sonagrams of the nonsense words [bənja] and [bəɲa]

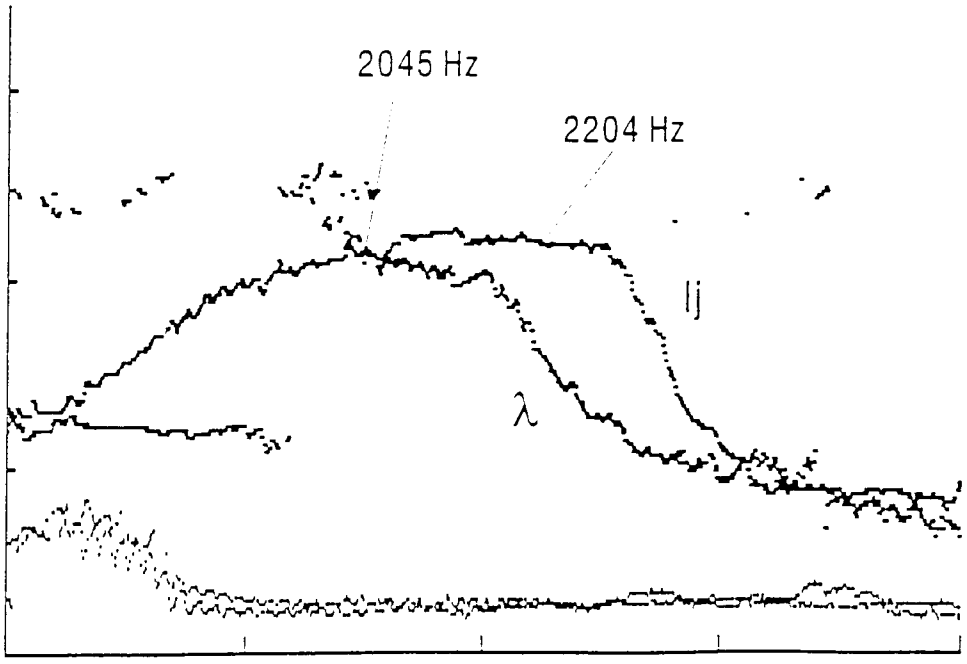

Figure 2: time-normalized LPC formants tracks of the nonsense words [ruʎa] and [rulja]

CONCLUSION

The data show that the the differences to be found are mainly related to reorganisations of the time function, and therefore confirm inferences which have been drawn from palatographic articulatory findings by Recasens (4, 5). His results showed that the articulatory differentiation between the palatals and the corresponding sequences was determined by two different chronological strategies. In the case of the palatal phonemes, the alveolar constriction and the palatal constriction appear quite simultaneously; a temporal delay exists between these two moments in the case of the sequences [nj] and [lj]. Recasens suggested thet the formation of the alveo-palatals in the romance languages, derived from the latin sequences with [i], can be explained as the result of the lost of the temporal delay between alveolar and palatal articulations.

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