

A CONTRASTIVE ANALYSIS OF SPANISH AND CATALAN RHYTHM

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ABSTRACT.

Durations of syllables, segments and pauses of similar texts in two languages, Catalan and Spanish, are compared at three speech rates: slow, normal and fast. These texts are read by one native speaker of each language. Results reveal that, although the temporal compression phenomenon has not exactly the same behaviour, both languages seem to be syllable-timed. Catalan tends to a proportional reduction in all syllables; Spanish tends to a more proportional duration of all syllables through stressed syllable reduction.

1. INTRODUCTION.

The aim of this paper is to study temporal compression of segments and syllables in Catalan and Castilian Spanish due to the influence of increasing speech rate. This temporal compression phenomenon is expected to be different in the two rhythmical categories traditionally classified: in stress-timed languages speech rate increase shows a higher degree of reduction in unstressed than in stressed syllables; in syllable-timed languages speech rate increase shows a proportional reduction in all syllables [1]. On the other hand, in syllable-timed languages, a 'greater speed' and an 'easier articulation' are achieved at the expense of consonants rather than vowels [3].

According to the classical literature about Spanish we have considered it to be a syllable-timed language [5]. Catalan has still not been studied from this perspective, although there are acoustic cues which indicate that it belongs to the

same rhythmical category [2]. For this reason, a similar behaviour is supposed to occur in the temporal compression phenomenon.

2. PROCEDURE.

2.1. Corpus.

We have analyzed two versions, in Catalan and Spanish, of the same text: the fable "The North Wind and The Sun" (see Den Os [4] for the study of this same text in Dutch and Italian). It was read at three different speech rates, slow, normal and fast, by a native speaker of each language.

2.2. Subjects.

One native speaker of Catalan and one native speaker of Spanish acted as informants. Both were male and they were speakers of the standard variety of their languages. They had no difficulty at speaking at the requested speech rates.

2.3. Recording and acoustic analysis.

The speakers read the texts at three speech rates in one single recording session. It took place in a sound isolated room in semi-anechoic conditions at the Phonetics Laboratory at the Universitat Autònoma de Barcelona. A Sennheiser MD 441N directional cardioid microphone and a Revox A77 tape recorder were used.

The signal was digitized at 10 KHz sampling rate using the routines implemented in the MacSpeech Lab II software package by GW Instruments running on an Apple Macintosh II.

The audio wave was segmented and durations were measured on the oscillographic representation, locating the

boundaries of sounds using changes in the waveform as the main criteria. When necessary, spectrograms and perceptual checking listening to the segments were also used.

3. RESULTS.

The Catalan text contains 171 linguistic syllables and Spanish one contains 179. The overall time of readings (included pauses) of the Catalan version is 39.1 s. (slow), 32.4 s. (normal) and 25.8 s. (fast) and of the Spanish version 37.1 s. (slow), 32.9 s. (normal) and 26.4 s. (fast). This means that the overall speech rate -expressed in linguistic syllables per second- in Catalan readings is 4.4 (slow), 5.3 (normal) and 6.6 (fast) and in Spanish readings is 4.8 (slow), 5.4 (normal) and 6.8 (fast). The number of syllables per time unit seems to be a good objective measure of speech rate. The versions of the languages may be compared with respect to speech rate. Values for each speech rate in the two languages are similar and there is an inversely proportional relation between speech rate increase and total duration decrease as expected.

The overall time of pauses in Catalan is 5.7 s. (slow), 5.3 s. (normal) and 3.6 s. (fast) and in Spanish is 8.9 s. (slow), 6.5 s. (normal) and 3.7 s. (fast). Values are higher in Spanish than in Catalan except in the fast reading, in which they are practically the same. The articulatory time (excluding pauses) in Catalan is 33.4 s. (slow), 27.1 s. (normal) and 22.2 s. (fast) and in Spanish is 28.2 s. (slow), 26.4 s. (normal) and 22.7 s. (fast). The articulatory rate -expressed in linguistic syllables per second- in Catalan is 5.1 (slow), 6.3 (normal) and 7.7 (fast) and in Spanish 6.3 (slow), 6.8 (normal) and 7.6 (fast). We observe that articulatory rate increase in Catalan is proportional in the three readings, but in Spanish there is a weak increase between slow and normal readings, and a more noticeable increase between normal and fast readings. Anyway, articulatory rates corresponding to slow and normal readings have a higher value in Spanish than in Catalan, although the differences between articulatory rate values decrease; and, finally, the values for fast reading in both languages tend to be similar.

The number of syllables realized in Catalan readings is 166 (slow) and 165 (normal and fast), and in Spanish readings is 178 (slow and normal) and 177 (fast). The overall speech rate -expressed in phonetic syllables per second- in Catalan readings is 4,3 (slow), 5,1 (normal) and 6,4 (fast), which are perfectly comparables with Spanish values: 4.8 (slow), 5.4 (normal) and 6.7 (fast). Articulatory speech rate expressed in phonetic syllables, but the fast reading value is not so similar between both languages. Those values for Catalan are 5.0 (slow), 6.1 (normal) and 7.4 (fast) and for Spanish 6.3 (slow), 6.7 (normal) and 7.8 (fast).

It is then clear that there are some problems connected with expressing speech rate in syllables per second. Questions arise as to whether pause-time has to be included and which types of syllables have to be counted, phonetic or linguistic ones. We have computed the overall values of linguistic and phonetic syllables, and of speech and articulatory rate. But we have taken only into account values of phonetic syllables because they correspond to the actual phonetic realization; for the same reason, values corresponding to speech rate have been used, because among other factors, it is not possible to distinguish pauses from stop gaps occurring after a pause. Then if we take only into account articulatory rate values, some information would be lost.

In order to study the temporal compression phenomenon as a function of the speech rate increase, regression analysis has been applied taking into account the following conditions for three speech rates in both languages:

(a) the overall speech rate, expressed in phonetic syllables per second as an independent variable.

(b) as dependent variable, in each case: the mean duration of unstressed syllables, stressed syllables, vowels, stressed vowels, unstressed vowels, Catalan schwa, consonants, obstruents, and sonorants.

The relative decrease in duration per syll/s is the following:

3.1. Syllables. Catalan unstressed and stressed syllables show an analogous shortening, which is higher in the stressed than in the unstressed ones (30.6 vs. 25.8). Spanish stressed syllables shorten to a lesser extent considering the behaviour Catalan syllables (20.4), and Spanish unstressed syllables present an even lower degree of shortening (7.2). See Figure 1.

3.3. Stressed vowels vs. unstressed vowels. Differences in shortening between stressed and unstressed vowels in both languages are clear, although they are more prominent in Spanish (10.6 and 4.3) than in Catalan (18.2 and 9.0, respectively). Catalan has a schwa, which undergoes a shortening similar to the overall unstressed syllables (10.4). See Figure 3.

4. DISCUSSION.

All categories studied show a higher degree of shortening in Catalan than in Spanish. Considering that in Spanish the three speech rates are a bit higher and the shortening is a bit lower than in Catalan, we can expect that temporal compression as a function of the speech rate increase would be smaller in Spanish than in Catalan.

On the other hand, considering that stressed syllables have the longest duration in Spanish, the fact that they are subject to a higher degree of shortening than unstressed ones reveals a strong tendency towards equal syllable duration. The same phenomenon is found for vowels in both languages. This seems to imply that Spanish and Catalan tend to syllable-timed languages.

The ratio between the degree of reduction of vowels vs. consonants is the same in both languages (1.5). Temporal compression of vowels is higher than of consonants. The behaviour of those syllable types in Spanish seem to be in disagreement with Dauer conclusions [3]. However, we believe this behaviour is coherent with the results obtained in our experiment, which reveal that the categories of syllables and segments with longer mean duration are shortened in a higher degree. According to Bertinetto [1], we can conclude that Catalan and Spanish are not stress-timed languages, because speech rate increase does not show a higher degree of reduction in unstressed than in stressed syllables. They would be then considered syllable-timed languages: Speech rate increasing in Catalan shows a proportional reduction in all syllables. Speech rate increasing in Spanish shows a higher reduction in stressed syllables than in unstressed ones, although stressed syllables are always the longest ones. Then, there is a tendency to shorten longer segments and stressed syllables most. Through stressed syllable reduction, proportional duration of syllables tends to be achieved.

5. CONCLUSION.

It has been shown that both languages tend to be syllable-timed, although the processes involved are not exactly the same. The fact that Spanish seems to make equal syllable durations (through stressed syllable reduction related to speech rate increase) suggests that its rhythm is syllable-timed as it has been traditionally defined: syllables recur at regular intervals. In Catalan the temporal compression is more marked almost equally in all syllables, so that we can presume that its rhythm is syllable-timed in agreement with Bertinetto's proposal [1]. However, in order to characterize a language from a rhythmic point of view there are other factors to be taken into account. Furthermore, we are aware of problems concerned with our experiment: - segmental reduction is also constrained by syllable structure, segment position in the utterance or speech style. - the fact that reading rates are constrained affects the degree of naturalness of the corpus. - the preliminary results of this study suggest that more research is still needed in order to describe accurately the temporal compression phenomenon.

6. REFERENCES.

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3.2. Vowels vs. Consonants. Vowels and consonants are subject to a similar shortening in both languages; however it is lower in Spanish (6.2 and 4.2) than in Catalan (12.6 and 8.7, respectively). See Figure 2.

3.4. Obstruents vs. sonorants. In Spanish there is a great difference in the shortening between both types of consonant categories (6.1 and 1.5). In Catalan, in which the degree of shortening is higher differences between sonorants and obstruents are not so important (9.6 and 7.0 respectively). See Figure 4.

