

## TIMING IN CATALAN

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#### ABSTRACT

This study is a preliminary analysis of timing organization in Catalan. The topics under investigation are compression of stress groups and stressed syllables, final lengthening, and rhythmic alternation in unstressed syllables.

#### 1. INTRODUCTION

Recent phonetic studies on speech timing disclaim a strong version of the opposition between syllable-timed (i.e., Spanish, French) and stress-timed (i.e., English, Swedish) languages. There is little evidence (if any) for isochrony within the syllable or foot domain in the two language types; instead syllable and foot duration appears to increase as a function of segmental complexity.

To cope with this negative finding two alternative views have been proposed. Some scholars [2, 10] believe that languages are perceived as syllable- or stress-timed because of phonological factors. Thus, in contrast to syllable-timed languages, stress-timed languages allow complex consonant clusters in coda position, and may reduce all vowels to schwa in unstressed position. Moreover, the addition or suppression of schwa affects syllabification in the former (i.e., French) vs the latter language group. Phoneticians are however reluctant to abandon acoustic and articulatory timing measures. It seems now well established that there is no clearcut dichotomy between the two language types. Moreover rhythmic differences among languages probably reflect the contribution of several durational and spectral constraints [6].

In this paper I will look for phonetic correlates of timing organization in Catalan. In spite of Catalan being a Romance language, its phonological make-up does not fully accord with that of other syllable-timed languages such as

Italian or Spanish. Indeed Catalan allows consonant clusters up to three segments in syllable-final position and has a schwa in unstressed position. Differently from English, Catalan [ə] always behaves as a syllable nucleus (as in French). Because of its particular phonological structure, Catalan is a good candidate to test the interaction of phonetic and phonological factors in the rhythmic structure of languages.

#### 2. METHOD

Three Catalan speakers were asked to read a list of nine nonsense words. In order to preserve naturalness in the reading task each nonsense sequence was uttered after a meaningful Catalan sentence with the same stress pattern and syllable structure. The nonsense words were preceded by the stressed monosyllabic Catalan word *fa* ('he says'). They were composed of one stressed syllable ([pa]) and zero, one or two preceding and/or following unstressed syllables ([pə]) (see Table I). Schwa can appear in unstressed position in Catalan.

Several segmental units were measured from waveform displays, namely, stress group (a stressed syllable preceded or followed by 0, 1 or 2 unstressed syllables), vowel (stressed [a] and unstressed [ə]), and consonant (stressed and unstressed [p]).

#### 3. RESULTS

##### 3.1. Stress group durations

Measurements show a monotonical increase in stress group duration with the number of syllables within the group for all sequences. The two variables are highly correlated ( $r = .9, 1$  and  $1$  according to speaker). This is exemplified in Figure 1 which displays durations of one-, two- and three-syllable size stress group intervals according to

speaker Rc.

A linear correlation between the two variables is not exclusive of syllable-timed languages [French: 5; Italian: 10] but has been documented in stress-timed languages as well [Dutch: 10; English: 9].

##### 3.2. Final lengthening

There is very scant evidence in support of the hypothesis that syllable timing organization is incompatible with final lengthening. Final lengthening has been reported to occur in French [5], Spanish and Japanese [7]. It does not show up however in Italian stressed syllables and vowels [12].

Final lengthening in Catalan was calculated separately for stressed and unstressed syllables, vowels and consonants. In all cases it was equated to the ratio between average durations in final vs medial position.

All speakers show robust final lengthening effects, more so for unstressed vs stressed syllables, vowels and consonants [English: 9; Italian: 12], and for stressed and unstressed vowels vs consonants [French: 5].

Stress- and syllable-timed languages may differ in the magnitude of the lengthening effect. In support of this hypothesis there is less stressed vowel final lengthening in Catalan (38%, 22% and 24% according to speaker) than in English (50%) [6] oxytone vs paroxytone sequences.

##### 3.3. Compression of stressed vowels and consonants

In comparison to syllable-timed languages, stress-timed languages are expected to show a higher degree of compression of stressed syllables duration as a function of the number of unstressed syllables within the stress group. Moreover sensitivity to compression effects may depend on whether the unstressed syllables precede (carryover compression) or follow (anticipatory compression) the stressed syllable.

Significant anticipatory effects at the  $p < .01$  level were found for stressed [a] when the number of following unstressed syllables increases

(a) from 0 to 1 in all sequences (i.e., [pa] vs [papə], [pəpa] vs [pəpəpə], [pəpəpa] vs [pəpəpəpə]) for all speakers;

(b) from 1 to 2 in all sequences (i.e., [papə] vs [papəpə], [pəpəpə] vs [pəpəpəpə], [pəpəpəpə] vs [pəpəpəpəpə]) for two speakers and in only one of those three sequence types for the other speaker.

Consistently with data from the literature, there is less anticipatory compression for consonants than for vowels since it only occurs in the 1 vs 2 syllables condition when no syllable precedes the stressed syllable (i.e., [pə] vs [papə]) (all speakers).

Carryover effects on vowel and consonant duration are only significant in some cases when the number of preceding syllables increases from 0 to 1 and no syllable follows the stressed syllable (i.e., [pa] vs [pəpa]).

Figure 2 illustrates anticipatory and carryover compression effects for stressed syllables according to speaker Rc. The figure shows much less stressed syllable shortening (and thus much less stressed vowel shortening) in the 2 vs 1 than in the 0 vs 1 following syllables condition. In particular stressed vowels in paroxytones are shorter than those in paroxytones by 13%, 11.5% and 10% according to speaker.

Data for Catalan presented here are somewhat consistent with those for other stress-timed languages showing larger anticipatory than carryover compression effects and thus suggesting the existence of a left-dominant foot structure [Swedish: 8; English: 6]. Concerning syllable-timed languages a similar trend has been found for Italian [13]. Other stress-timed languages show no anticipatory compression effects [Japanese, Spanish: 7], or do not favor right-to-left vs left-to-right compression trends [Spanish: 11].

##### 3.4. Unstressed syllables

Statistical analysis on unstressed syllables duration allows drawing the following conclusions:

(a) differences in duration among unstressed syllables are not larger than 8 to 10 % of the mean unstressed syllables duration;

(b) for all speakers pretonic unstressed syllables which are located two syllables away from the stressed syllable (i.e., word absolute initial unstressed syllables) are the shortest of

all unstressed syllables in the word;

(c) for two speakers posttonic unstressed syllables which are adjacent to the stressed syllable are particularly long.

The fact that durational differences across unstressed syllables are particularly small conforms better to a syllable-timed than to a stress-timed language model [see 3 for discussion].

Moreover, Catalan unstressed syllables show a rhythmic pattern which has also been reported for other syllable-timed languages, with weak initial unstressed syllables and strong medial unstressed syllables (more so if immediately posttonic). Indeed unstressed syllable duration in Spanish and Japanese decreases in the progression final>medial>initial [7]; moreover it has also been found for French that two pretonic unstressed syllables should conform to a weak-strong (W-S) pattern [3]. Stress-timed languages usually show significant shortening of unstressed syllables next to a stressed syllable [7]. Therefore in languages of this group syllables duration within the word decreases in the progression final>initial>medial [Swedish: 1; English: 7]. Italian researchers have also found shorter unstressed syllables in word medial vs absolute initial position in Italian [4].

#### 4. SUMMARY

Analogously to syllable-timed and stress-timed languages Catalan shows final lengthening and a stress group duration which is proportional to the number of syllables within the group. Differently from syllable-timed languages such as Spanish, Catalan appears to favour anticipatory vs carryover compression of stressed vowels within the stress group; analogously to Italian this trend is probably weaker than in stress-timed languages. Like other syllable-timed languages, positional realizations of [ə] differ little in duration and shorten when adjacent to unstressed syllables but not to stressed syllables.

#### ACKNOWLEDGMENTS

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TABLE I. List of nonsense words used in the experiment.

1. ['pa]
2. ['papə]
3. ['papəpə]
4. [pə'pa]
5. [pə'papə]
6. [pə'papəpə]
7. [pəpə'pa]
8. [pəpə'papə]
9. [pəpə'papəpə]

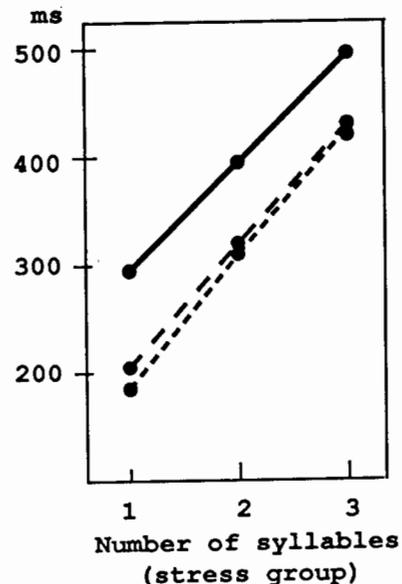


FIGURE 1. Stress group duration as a function of the number of syllables (speaker Re). The data are represented separately for oxytone (continuous line), paroxytone (dashed line) and proparoxytone (dotted line) nonsense words.

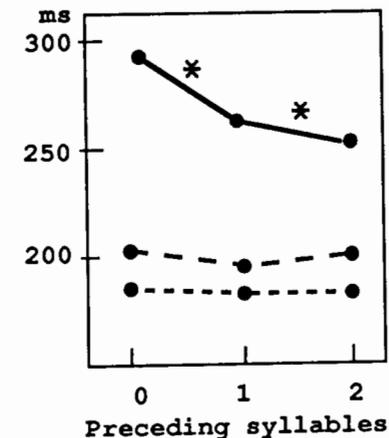
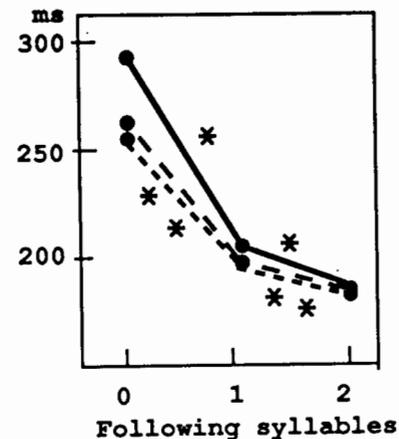


FIGURE 2. Anticipatory (upper graph) and carryover (lower graph) compression of stressed syllables as a function of the number of unstressed syllables in the stress group (speaker Re). The data are represented separately for one (continuous line), two (dashed line) and three (dotted line) preceding (anticipatory compression condition) and following (carryover compression condition) syllables. Significant compression effects are marked with an asterisk.