

Catalan Pre-Nuclear Accents: Evidence for Word Edge Tones

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ABSTRACT

The phonological interpretation of pre-nuclear rising accents in Catalan declaratives is examined within the Autosegmental-Metrical framework. Former studies have shown that pre-nuclear rises can neither be described as L^*+H (the H is not located at a fixed distance from L^* as expected in bitonality) nor as H^* with peak delay (there is no correlation between syllable duration and location of the peak). In this paper, a third option is investigated, namely, a pitch accent (L^*) and a word edge tone (H). Words with different stress distributions (oxytones, paroxytones and proparoxytones) are analysed to examine the effects of a word boundary on the alignment of the F0 peak. 180 sentences were recorded by two Catalan speakers. The results show that the F0 peak is consistently anchored at the end of the word no matter the number of post-accented syllables. Thus, pre-nuclear rises are interpreted as the combination of L^* and H.

1. INTRODUCTION

The aim of this paper is to examine the effects of a word boundary on the location of an F0 peak in pre-nuclear rising accents in Catalan neutral declaratives. Previous studies on the unmarked intonation of declarative sentences in Catalan ([1], [2]) have shown that pre-nuclear accents are produced with a rising movement whose peak tends to be aligned after the accented syllable. [2] has shown that the phonological interpretation of such rises within the Autosegmental-Metrical approach of intonational analysis ([3]) presents some problems since neither a bitonal accent (such as L^*+H) nor an H^* with peak delay are able to account for the rising movement. First, the H is not located at a fixed distance from the L^* as expected in bitonal accents ([4]) and second, there is no correlation between the duration of the syllable and the location of the peak, as predicted in a delayed H^* ([5]).

A third possible interpretation of such rises is examined in this study, namely, the presence of two tones: a pitch accent (L^*) associated to the accented syllable and a word edge tone (H) anchored at the end of the word. If it is true that the H is located at the right edge of words, the presence of the F0 peak at the end of the word must be consistent no matter the number of unstressed syllables after the accented one.

Thus, in this paper, words with three stress distributions are considered, namely, oxytones (words with stress on the last syllable), paroxytones (words with stress on the

penultimate syllable), and proparoxytones (words with stress on the antepenultimate syllable). The predictions are as follows: if the H signals the right edge of words, the F0 peak will be anchored at the end of the word no matter how many unstressed syllables appear after the accented syllable. In oxytones, the F0 peak should coincide with the end of the accented syllable, which is the last syllable of the word. In paroxytones, the F0 peak will be located at the offset of the post-stressed syllable, and in proparoxytones at the offset of the second post-stressed syllable.

2. EXPERIMENTAL DESIGN

In order to test the possible presence of word edge tones in Catalan, 90 neutral subject-verb-object declarative sentences consisting of words with different stress distributions in pre-nuclear position (i.e. on the subject and on the verb) were designed. Three stress distributions were taken into account, namely, oxytones, paroxytones and proparoxytones. Each stress distribution consisted of 30 different items. An example of the three stress distributions in subject position is provided in (1) below. In each case, the stressed syllable is underlined.

- (1) *En Ramon nega la maionesa*
La Mila nega la maionesa
La Melanie nega la maionesa
(“Ramon/Mila/Melanie spoils the mayonnaise”)

Two female speakers of the Central variety of Catalan were asked to read the 90 sentences as if they were answers to a “what happens?” question type, i.e. with a broad focus or neutral declarative reading. The Central Catalan accent was chosen since it is considered to be the standard accent. A reading task was used to be able to control the segmental string and hence design sentences with the maximum number of voiced segments possible so as to avoid interrupted F0 traces. Overall, 180 utterances were recorded. In this paper, the speakers are identified as DV and CP.

The recordings included two simultaneous but separate signals: speech and laryngeal (Lx) signals. For the speech signal, a Marantz Superscope/CD 330 tape recorder and a Beyer Dynamic microphone were used. For the laryngeal signal, a portable laryngograph LX 12 with two electrodes was used. A Thandar portable DRO 26 oscilloscope was also used to check the activity of the vocal folds.

The analysis of the data was performed by means of SFS (Speech Filing System) which allowed us to carry out a

time-aligned inspection of the speech waveform and the F0 trace. An example of the SFS display is presented in Figure 1 for the sentence *La Mila nega la maionesa* produced with two pre-nuclear rising accents.

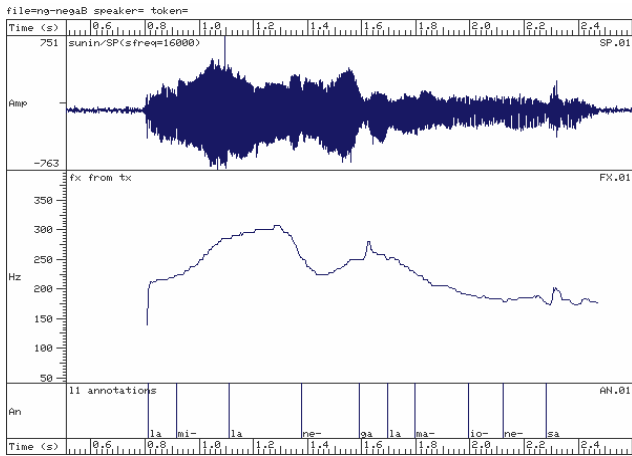


Figure 1: Speech waveform and F0 trace for the sentence *La Mila nega la maionesa* produced with two pre-nuclear rising accents. The onset of each syllable is marked in the box at the bottom.

The possibility that the H in pre-nuclear rising accents is located at the end of the word was tested empirically by taking the following measurements from all pre-nuclear accents: 1) distance between the onset of the accented syllable and the location of the F0 peak (on-peak), and 2) distance between the onset of the accented syllable and the end of the word (on-end).

3. RESULTS

The results of the measurements for oxytones, paroxytones and proparoxytones both in initial and in medial positions (i.e. on the subject and on the verb) are presented in Figures 2, 3 and 4. Each figure includes the data of both speakers. The graphs plot the distance between the onset of the accented syllable and the location of the F0 peak (on-peak) against the distance between the onset of the accented syllable and the end of the word (on-end). The regression lines summarise the correlations observed between the two variables. R^2 values are included in each graph.

3.1 Oxytones

The results presented in Figure 2 for words with stress on the last syllable show that for both speakers there is a strong correlation between the two variables. In both cases R^2 values are bigger than 0.95, indicating an almost perfect correlation. Thus, for oxytones the F0 peak seems to be anchored at the end of the word which in this case also corresponds to the end of the accented syllable.

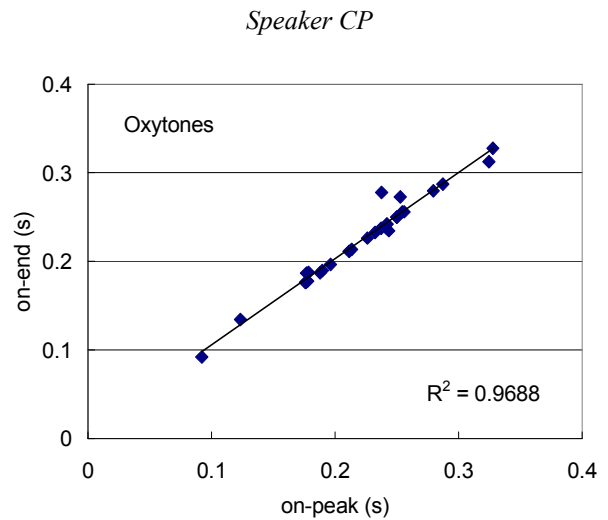
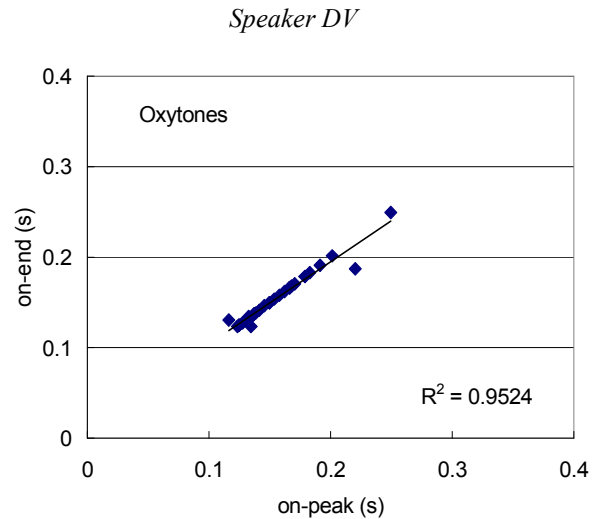


Figure 2: Distance between the onset of the accented syllable and the F0 peak (on-peak) against distance between the onset of the accented syllable and the end of the word (on-end) in seconds (s) for speakers DV and CP in oxytones.

3.2 Paroxytones

Similar to oxytones, the results displayed in Figure 3 for paroxytones show that for both speakers there is a strong correlation between the “on-peak” distance and the “on-end” distance (speaker DV: $R^2=0.81$; speaker CP: $R^2=0.91$). According to these results, the F0 peak seems to be anchored at the end of the word, which for paroxytones is at the offset of the post-stressed syllable.

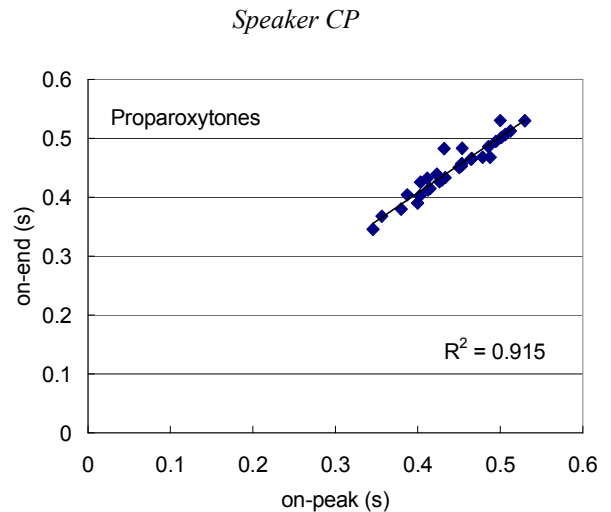
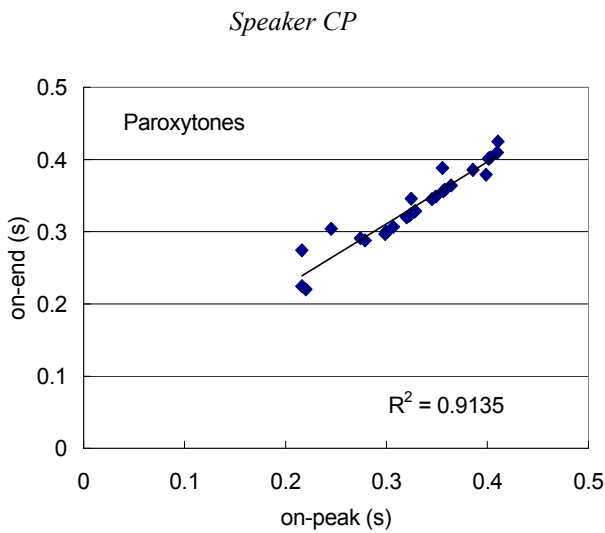
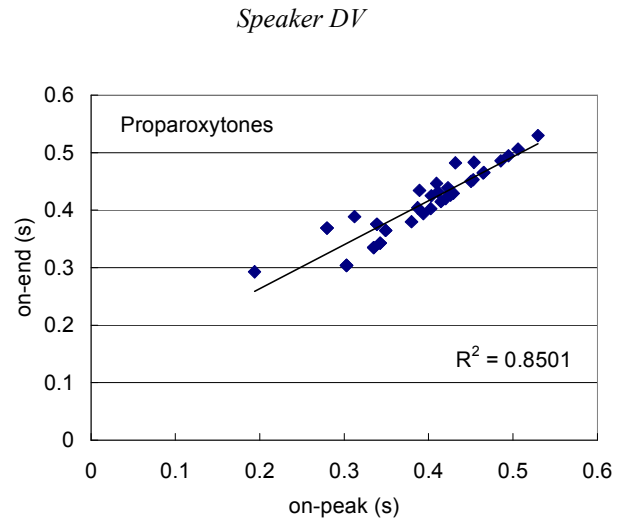
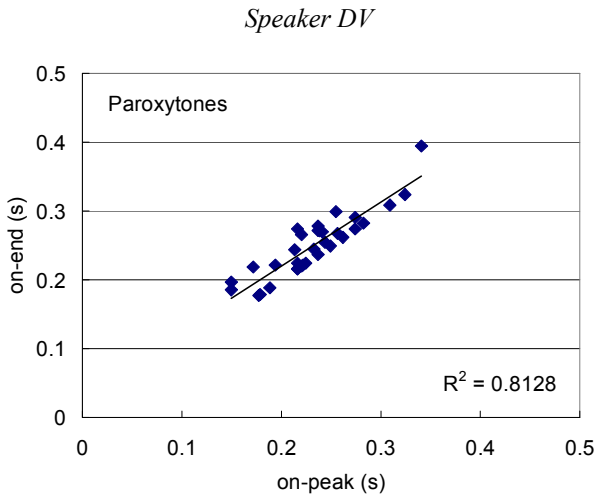


Figure 3: Distance between the onset of the accented syllable and the F0 peak (on-peak) against distance between the onset of the accented syllable and the end of the word (on-end) in seconds (s) for speakers DV and CP in paroxytones.

3.3. Proparoxytones

Finally, as displayed in Figure 4, the results for proparoxytones are very similar to those for oxytones and paroxytones. Both speakers show a strong correlation between the “on-peak” distance and the “on-end” distance (speaker DV: $R^2=0.85$; speaker CP: $R^2=0.91$). This indicates that the F0 peak seems to be anchored at the end of the word, which for proparoxytones is the offset of the second post-stressed syllable.

Figure 4: Distance between the onset of the accented syllable and the F0 peak (on-peak) against distance between the onset of the accented syllable and the end of the word (on-end) in seconds (s) for speakers DV and CP in proparoxytones.

4. DISCUSSION

In this study the phonological interpretation of pre-nuclear rising accents in Catalan declaratives has been analysed. In particular, the hypothesis that word boundaries have an effect on the alignment of the F0 peak has been taken into account. Three types of words with different stress distributions have been examined (i.e. oxytones, paroxytones and proparoxytones) for two speakers. A time-aligned inspection of the speech waveform and the F0 trace has been performed so as to inspect the location of the F0 peaks in relation to the right edge of words. The results show that for both speakers and for all kinds of words there is a strong correlation between the “on-end” distance (i.e. distance between the onset of the accented syllable and the end of the word) and the “on-peak” distance (i.e. distance

between the onset of the accented syllable and the location of the F0 peak). Thus, the F0 peak seems to be located at the end of the accented word, no matter the number of post-stressed syllables. These results indicate that the tonal interpretation of Catalan pre-nuclear rising accents involves an H word edge tone associated to the right edge of the word. Further research is needed to provide an appropriate phonological description of the F0 trough aligned within the pre-nuclear accented syllables. In this paper, we propose to interpret such troughs as L* and thus account for pre-nuclear rises in Catalan declaratives as the combination of an L* pitch accent and an H word edge tone.

The interpretation of pre-nuclear rising accents in declaratives sentences varies cross-linguistically and sometimes studies on the same language maintain competing views for the phonological description of such rises. [6] proposes the bitonal accent L*+H to describe pre-nuclear rises in Greek based on the stability in the alignment and in the scaling of the starred L. However, further research in Greek ([7]) shows that there is no clear evidence of which of the two tones is aligned with the accented syllable and hence a new interpretation is proposed, namely, (LH). Similar controversial views have been argued for Spanish. Some studies on Spanish intonation ([5]) have classified those accents as an H* pitch accent which is subject to peak delay depending on the duration of the accented syllable and the presence of a prosodic boundary. This interpretation, however, is at odds with [8] and [9] who account for pre-nuclear rises as L*+H based on the low F0 within the accented syllable. Finally, [10] proposes (L+H)* since, as in Greek, it is unclear which of the two tones is associated to the accented syllable.

The results presented in this study for the Catalan data provide evidence for another interpretation of pre-nuclear rises in this language, namely, the combination of two tones: a monotonal pitch accent (L*) associated to the accented syllable and a word edge tone (H) associated to the end of the word. These findings have an important implication for phonological theory, that is, the relevance of the word domain as an anchor for tonal entities. The presence of word edge tones has been postulated in other languages, such as Serbo-Croatian ([11]). In this language the phonological word is defined on two tonal events: a pitch accent and a word boundary tone. In contrast with Catalan, the Serbo-Croatian word-boundary tone appears to be in initial position. Similar to Serbo-Croatian, the results presented in this paper for Catalan show that in this language the word domain can be defined on intonational grounds.

5. CONCLUSIONS

In this paper the phonological interpretation of pre-nuclear rises in Catalan declaratives has been examined within the Autosegmental-Metrical approach of intonational analysis. Given the evidence presented in former studies on Catalan intonation that pre-nuclear rises can neither be described as L*+H nor as H* with peak delay, a third option has been

investigated in this paper, namely, the possibility that the F0 peak is aligned with the end of the accented word and hence signals the presence of an H word edge tone. Words with different stress distributions (oxytones, paroxytones and proparoxytones) have been analysed to observe the effects of a word boundary on the alignment of the F0 peak. 180 sentences were recorded by two Central Catalan speakers. The results show that for all types of words the F0 peak is consistently anchored at the end of the word no matter the number of post-accented syllables. These results indicate that Catalan pre-nuclear rises should be interpreted as the combination of an L* pitch accent associated to the accented syllable and an H word edge tone associated to the end of the accented word. Furthermore, the findings reported in this paper provide evidence that the word domain in Catalan can be defined on intonational grounds.

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