Stress clash in Spanish, Catalan, and Friulian from a prosodic perspective

Running title: Stress clash in Spanish, Catalan, and Friulian

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Abstract

In several languages two stresses cannot appear adjacently in the spoken chain, and a variety of solutions have been offered to fix this problematic encounter. According to different authors, a common strategy to solve stress clash is the non-realization of the first stress and, typically, a transfer of all stress parameters to the pretonic syllable.

This study aims to describe how stress clash is solved in three romance languages (Spanish, Catalan, and Friulian) and two sentence-types (broad focus statements and information-seeking yes-no questions). The first languages two behave similarly, insofar as length and loudness are not stress-supporting parameters, and F0 maintains the general patterns of the type of sentence. Friulian stands out because length is the main stress parameter and tonic syllables are significantly longer, even when there is a stress clash. F0 also follows the general sentence type pattern, with one exception: declarative sentences in NP1, where the pretonic syllable is always higher than its corresponding tonic.

1. Introduction

It would seem that, in many languages, two stresses cannot appear adjacently in the spoken chain, and a variety of solutions have been offered to fix this problematic encounter. Pamies (1994, 206) appears to indicate that one of the possibilities is the pervasive non-realization of the first stress. Prieto et al. (2001) defended that in Catalan, non-realization was the main way of repairing the stress collision, that is, these authors expressly state that "*la primera síl·laba implicada en el xoc experimenta una desaccentuació girabé sistemàtica*" [the first syllable involved in the clash is almost systematically de-stressed]. They add that the first acoustic clue of the phenomenon can be seen in the no-rise of the F0 of the first syllable. Almeida & San Juan's study (2001) about this clash in Canarian Spanish does not produce conclusive data. They claim that the stress retraction—giving more salience to the pretonic syllable—does not happen and that Canarian speakers tend to maintain lexical stresses. Atria (2009) studies the phenomenon in Chilean Spanish, and points out that in stress clash contexts, there is primarily only one tonal peak.

Our intention in this study is to contribute new data to this issue, because, without aiming to find stress collision contexts, we have come across them in the fixed corpus of AMPER, with sentences that allow us to conduct an exhaustive study of the issue. In addition, the corpus has the advantage of including several stress positions, as well as broad focus statements and information-seeking yes/no questions, thus it shows how intonation influences the behavior of adjacent stresses.

The first aspect to take into account is what parameter supports stress primarily, because studies over time have focused on loudness, length, and F0. Loudness was defended mostly by classic authors. Navarro Tomás (1918, § 159), for instance, states that it is "*el acento de intensidad, que en el estado actual de la pronunciación española influye más que ningún otro elemento en la estructura prosódica de la palabra...*" [the loudness stress, which in the present state of Spanish pronunciation influences more than any other element the prosodic structure of a word...]. Length has been defended by, among others, Garrido et al. (1993). Quilis claimed that it was the fundamental frequency that most influenced stress (1993, 400). Llisterri et al. (2003) show that two out of these three parameters are necessary, although they concede that the fundamental frequency is the main parameter: "*la asociación entre pico de F0 y acento, aunque no es suficiente, desempeña un papel importante en la identificación del acento léxico en palabras aisladas*" [the association between an F0 peak and a stress, although insufficient, has an important role in the identification of lexical stress in isolated words] (p.181).

Most studies about stress clashes in adjacent syllables are based on expressions designed with the study of the phenomenon in mind: *su papá pasa, su papá Paco* [her father passes by; her father Frank] (Almeida & San Juan 2001); *beber vino, comer cerdo* [to drink wine, to eat pork] (Pamies 1994)... In Catalan, the phrases used were those that opposed two possible interpretations: *camí net* vs. *caminet* or *sis temes* vs. *sistemes* [a clean path vs. a small path, or six themes vs. systems] (Prieto et al. 2001)... The intention was "*que el timbre y el entorno consonante no interfieran, comparando dos frases donde solo varía la distanica interacentual"* [that the pitch and the consonant context did not interfere, comparing two sentences where only the inter-stress distance varied] (Pamies 1994, 96). Our fundamental questions is whether the clash becomes

manifest in the same way in a statement and in a question or in the noun phrase in the subject and the predicate.

2. Method

The present study falls within the framework of the Multimedia Prosodic Atlas of the Romance Domain (*Atlas Multimedia de Prosodia del Espacio Románico* or AMPER) (Contini et al. 2002, Contini 2005, Fernández-Planas 2005, Fernández-Planas & Martínez-Celdrán 2007) that seeks to characterize geoprosodic linguistic patters, and that is carried out in several European and American countries where Romance languages are spoken. More specifically, this study fits within AMPERCAT (http://stel.ub.edu/labfon/amper/cast/index_ampercat.html), label that refers on the one hand to the workgroup of the University of Barcelona, and on the other, to the scope covered by the application of the idea and methodology of AMPER to the main linguistic varieties of, among other areas, Catalonia: Catalan and Spanish. We have also incorporated Friulian (Roseano & Fernández Planas 2013).

2.1. Corpus

The study focuses on declarative and interrogative sentences pronounced naturally and neutrally. All the sentences are independent clauses and are composed of three or four lexical stresses, with an S+V+O syntactic structure (for example in Spanish, *La guitarra se toca con paciencia.*); S+S.Exp[1]+V+O (for example in Spanish, *El saxofón clásico se*

[1] Exp means expansion. We can find, as can be seen in these schematic structures, subject or object expansions. The expansion can be realized as an adjective or a prepositional phrase.

toca con paciencia.); or S+V+O+O.Exp (for example in Spanish, *El saxofón se toca con obsession práctica.*) for both broad focus statements and information-seeking yes/no questions. The tonal stress that corresponds to the verb is always on the second-to-last syllable, while the initial and final stresses, like the stresses of the expansion structures, cover all possible combinations for Spanish, Catalan, and Friulian, considering that these languages have three types of stresses, oxytone, paroxytone, and proparoxytone. Through these combinations we obtained sixty-three sentences of each sentence type—declarative and interrogative—for each language.

2.2. Analysis

After making the recordings, the files were digitalized, optimized, and a noise reduction algorithm was applied to them with the program *Goldwave*. Then, the files were analyzed strictly following the routines developed by the *Laboratorio de Fonética* from the University of Oviedo, and outlined in the program Amper 2006 (López Bobo et al. 2007), which in turn follow the routines established by the *Centre de Dialectologie* of Stendhal–Grenoble 3 University for the project AMPER in the *Matlab* environment. This project centers its attention on the study of the vowels contained in the sentences of the corpus, based on their segmentation in the phonic chain. Five values are obtained for each of these vowels: length, global loudness, initial fundamental frequency, fundamental frequency at its temporal midpoint, and final value of F0. Data files are generated using the mean value of several repetitions of the same sentence. This methodology is common throughout all work carried out under the auspices of the general AMPER project.

2.3. Objective

Our aim in this study is to contribute new data to the issue of stress clash, because without looking for collision contexts directly, we have come across them in the fixed corpus of AMPER, with sentences that allow us to perform an exhaustive study of the matter. We have studied, for instance, sentences in Spanish that contain stress situations like these:

(1) *El saxofón clásico se toca…* (clash location in noun phrase 1 (NP1))

(2) *La guitarra clásica se toca…* (1-syllable distance between the stresses of NP1)

(3) *La cítara clásica se toca…* (2-syllable distance between the stresses of NP1)

(4) *…se toca con obsesión práctica.* (clash location in noun phrase 3 (NP3))

(5) *…se toca con paciencia práctica.* (1-syllable distance between the stresses of NP3)

(6)*…se toca con pánico práctico.* (2-syllable distance between the stresses of NP3)

For Spanish, we have included data from 4 locations (Barcelona, Lleida, Caravaca de la Cruz, and Madrid). Recordings were made in each location of the declarative and interrogative sentences with male and female voices. From each informant, we analyzed 3 noun phrases with clash in NP1 and 3 in NP3, as well as 9 noun phrases without clash in NP1 and 9 in NP3, both in declarative and interrogative sentences (48 sentences x 2 informants x 4 locations = 384 items, of which 96 were with clash and 288 without clash). These same data is repeated for Friulian, with two informants from four survey points (Agrons, Beivars, Gradisca d'Isonzo, and Tesis). For Catalan, (two informants, man and woman, from Barcelona, Lleida, and Castelló de la Plana) we were only able to analyze NP1, because the sentences with expansion in NP3 of the AMPER-CAT corpus

do not present stress clash situations (24 sentences x 2 informants x 3 locations = 144 items, of which 36 were with clash and 108 without clash). Therefore, the total corpus is composed of 912 items (384 from Spanish, 384 from Friulian, and 144 from Catalan).

We have been able to manage all this wealth of raw data thanks to a semiautomatic system that reads the "txt" files generated during the vowel segmentation that forms part of the AMPER method and places the values of loudness, length and F0 of the vowel of each syllable position in an Excel or SPSS matrix for later statistical analysis, which allows us to compare mean values of the parameters of adjacent syllables with two criteria: T-test and the perception threshold. We are looking for statistically significant differences (margin of error under 0.05) as well as differences greater than the perception threshold between adjacent syllables relative to loudness, length, and fundamental frequency.

The thresholds are: 1.5 semitones in the case of F0 (Pamies et al. 2002). The differences in semitones are calculated with the formula $St= (12/\log_{10}2) \times (\log_{10} (F0_1/F0_2)$; for example, if the pretonic syllable of NP1 is at 125 Hz and the tonic syllable is at 147, the difference in semitones will be $(12/\log_{10}2) \times (\log_{10} (F0_1 (147)/F0_2 (125)) = (39.86) \times (0.07) = 2.7$ semitones; this difference is greater than the 1.5 st threshold.

One third will be the length threshold (Pamies & Fernández Planas 2006); for example, if the tonic syllable is 78 ms long, and the pretonic syllable is 65 ms long, the conclusion will be that the difference is below the threshold, because 78-65=13 and 13 is lower than 21.66, which is the third needed to be over the threshold (65/3=21.66); in

other words, the difference would be over the threshold if the tonic syllable were 87 ms long or longer (65+22=87).

Loudness does not appear to be an influential parameter in our perception of stress. A difference of 5 dB in favor of the /o/ in the [peko] sequence led 62% of our informants to state that it was *pecó*, keeping the length and fundamental frequency values constant. But 62% is a decidedly low value to consider that loudness might play a relevant role in speech; however, we have taken 5 dB to be the loudness threshold (Elvira García & Martínez Celdrán, submitted). Elvira García & Martínez Celdrán's experiment, with a difference of 3 dB only rendered 17% of informants to identify it as *pecó*, which is why we have ruled out this value as a threshold, in contrast to some studies that have taken it as threshold (Romito & Lorenzi 1997, Roullet 1999). In any case, we consider the difference between these two data is functionally important, or distinctive when the statistical data of the T-test are significant and over that threshold.

3. Results

3.1. Length

In Spanish, differences in length generally come under the threshold, so we cannot take length as a functional parameter of stress in any case. As tables 1-a and 1-b reflect, in a clash situation, la difference between tonic syllables is always smaller than a third, based always on the lower figure; for example, 67 and 52 (52/3=17.33, but the difference between 67 and 52 is 15 ms, which means that it would have had to be

greater than 17.33 to be over the threshold). Notice that in said tables, the differences in the case of no clash are always below the threshold. Additionally, if in NP1 in the no-clash situation there is –u –u –u +u, in NP3 we find the opposite: +u –u –u –u (see talbes in Annex 1): a clear proof that length is not significant.

Figure 1: Vowel length graphs of stress positions without clash in the NP1 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Madrid. The graphs correspond to the sentences *La guitarra clásica se toca con obsesión* and *¿La guitarra clásica se toca con obsesión?*

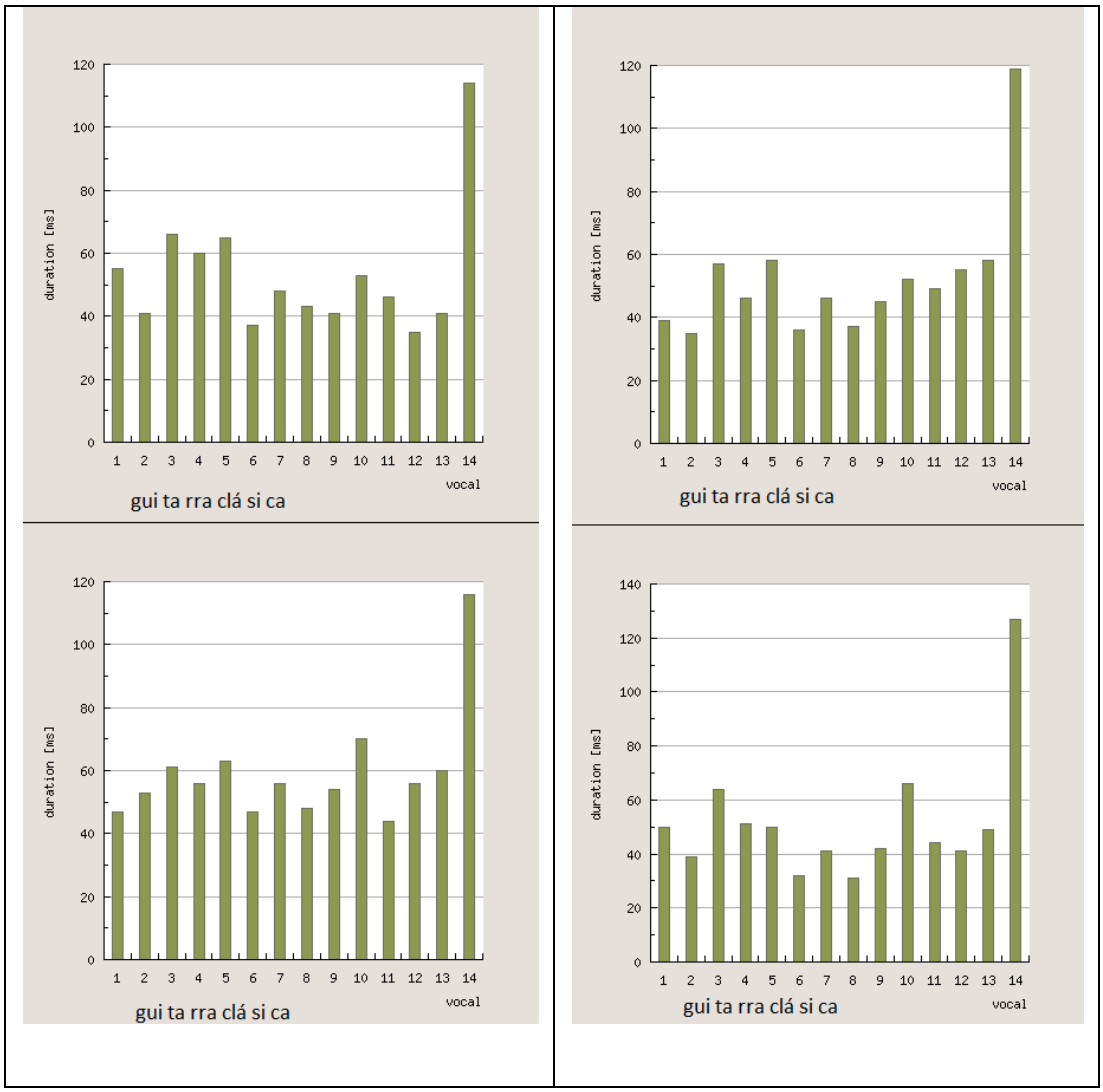


Figure 2: Vowel length graphs of stress positions without clash in the NP3 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Madrid. The graphs correspond to the sentences *El saxofón se toca con paciencia finita* and *¿El saxofón se toca con paciencia finita?*

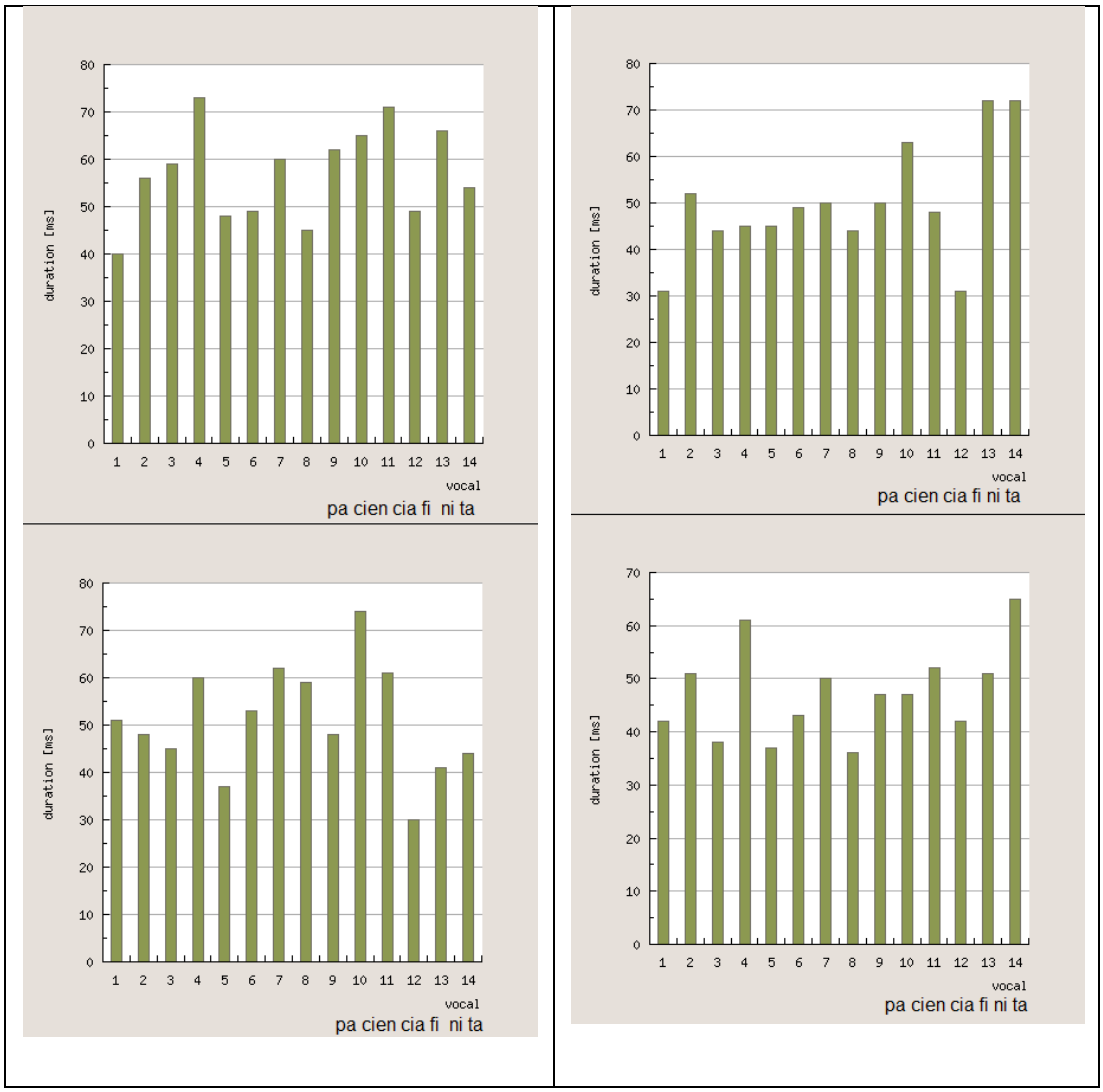


Figure 3: Vowel length graphs of stress positions with clash in the NP1 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Madrid. The graphs correspond to the sentences *El saxofón clásico se toca con obsesión* and *¿El saxofón clásico se toca con obsesión?*

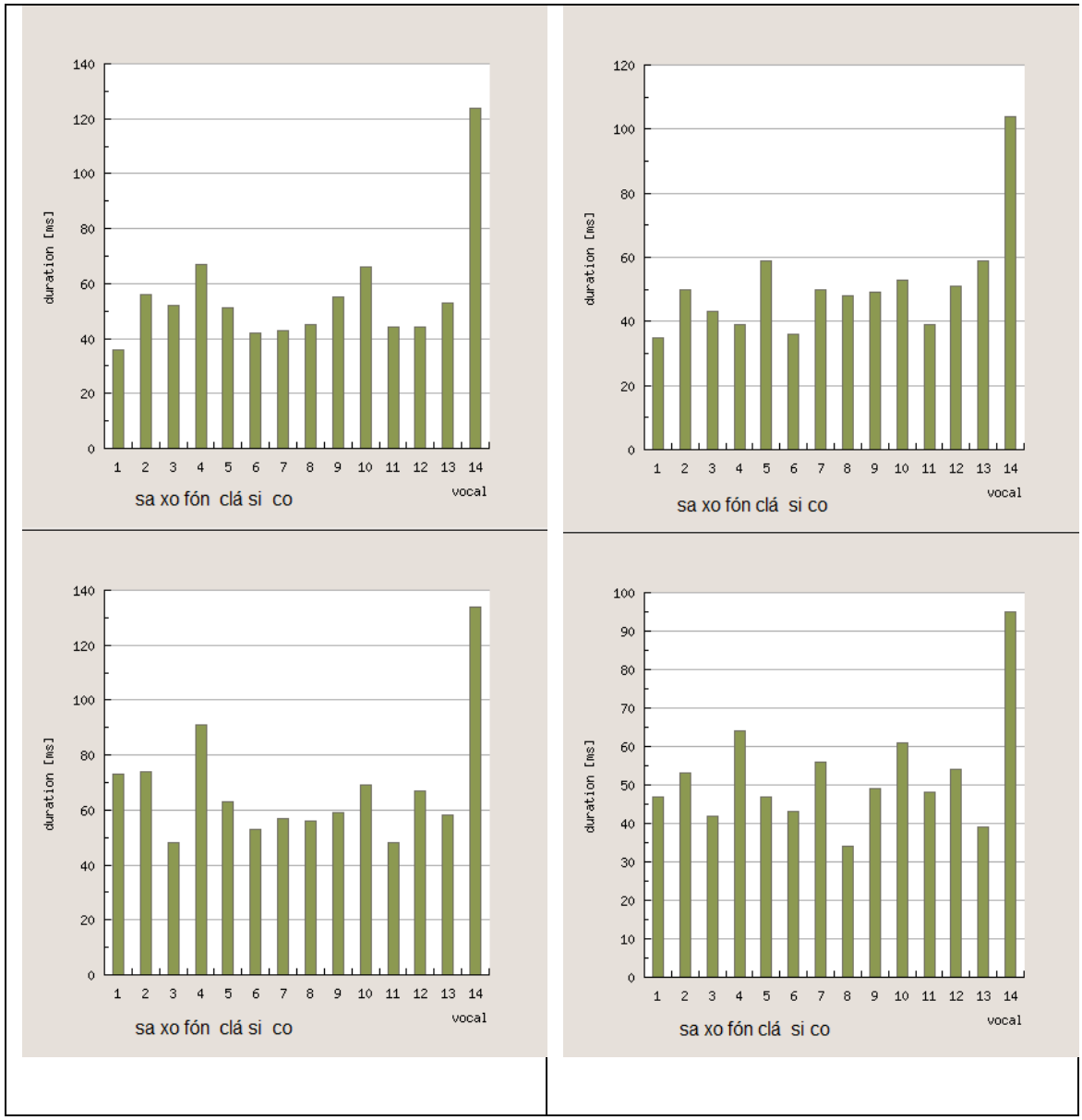
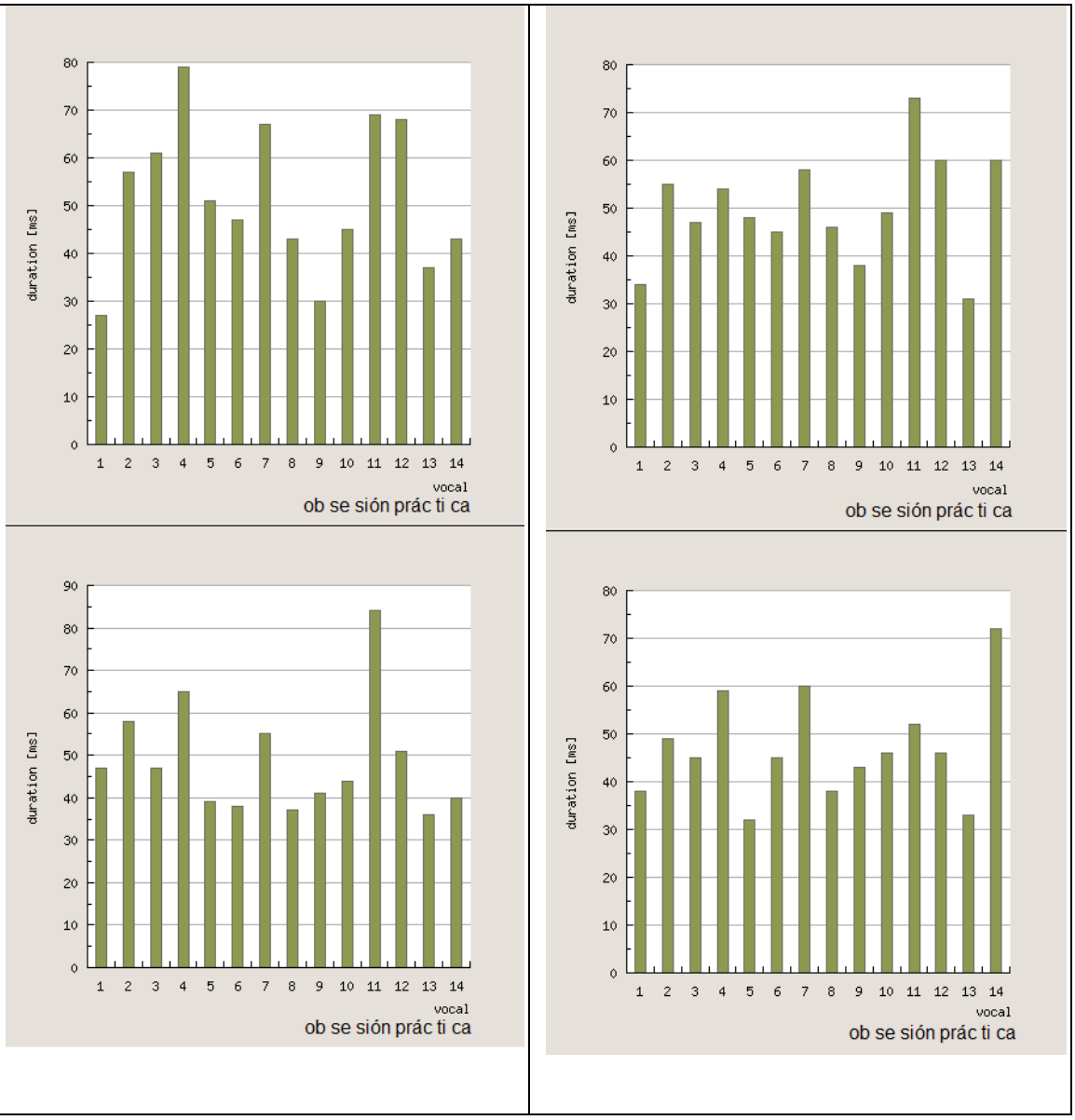


Figure 4: Vowel length graphs of stress positions with clash in the NP3 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Madrid. The graphs correspond to the sentences *El saxofón se toca con obsesión práctica and ¿El saxofón se toca con obsesión práctica?*



Catalan shows the same results (table 5), but the cases where the differences in length come under threshold are even greater, since in the no-clash situations all the differences appear below the threshold. In the clash situations, the differences are also under the threshold, all of this relative to NP1, because in Catalan, there are no cases of clash in NP3.

We have taken Friulian as a comparative term because it presents a significantly different situation to that of Catalan or Spanish. As can be seen in tables 9-a and 9-b, in the no-clash situations, the differences between the durations of the stressed and the adjacent syllables are over the threshold, which means that there are significant differences in terms of length. Additionally, the clash situation is special in that this is the only case in which the difference between the durations of the stressed and the adjacent syllables is below threshold, which means that both tonic syllables are maintained with equivalent lengths. It is true that the first one of them is always smaller: 102<114, 90<110, 106<125, and 98<115, which causes a slight weakening, but the difference is never greater than a third of the smaller figure (i.e. 90/3=30, but the difference between 90 and 110 = 20 ms, less than 30), which is why we say it is under threshold and, therefore, the difference is not perceptible to the ear. We must conclude that Friulian does possess a stress linked to length, something Catalan and Spanish do not, and that it does not avoid the clash because it maintains the lengths of the stressed syllables at equivalent values in terms of stress perception, although the first stressed syllable is indeed physically slightly weakened, but not enough to be perceived as de-stressed. In this case, there is no difference with Catalan and Spanish, where the differences in length between the two stressed syllables are also not over the threshold in the case of stress clash. The true difference between Friulian and the other two languages becomes manifest in the no-clash situation, because Friulian always maintains statistically significant differences which are also over the threshold, while in Catalan and Spanish these differences are generally below the threshold, although in many occasions there might be statistically significant differences, expressed through the data significance of the T-tests.

Figure 5: Vowel length graphs of stress positions without clash in the NP1 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Beivars. The graphs correspond to the sentences *La zòvine furlàne si sìnte sul savalòn* and *La zòvine furlàne si sìntie sul savolòn?*[2]

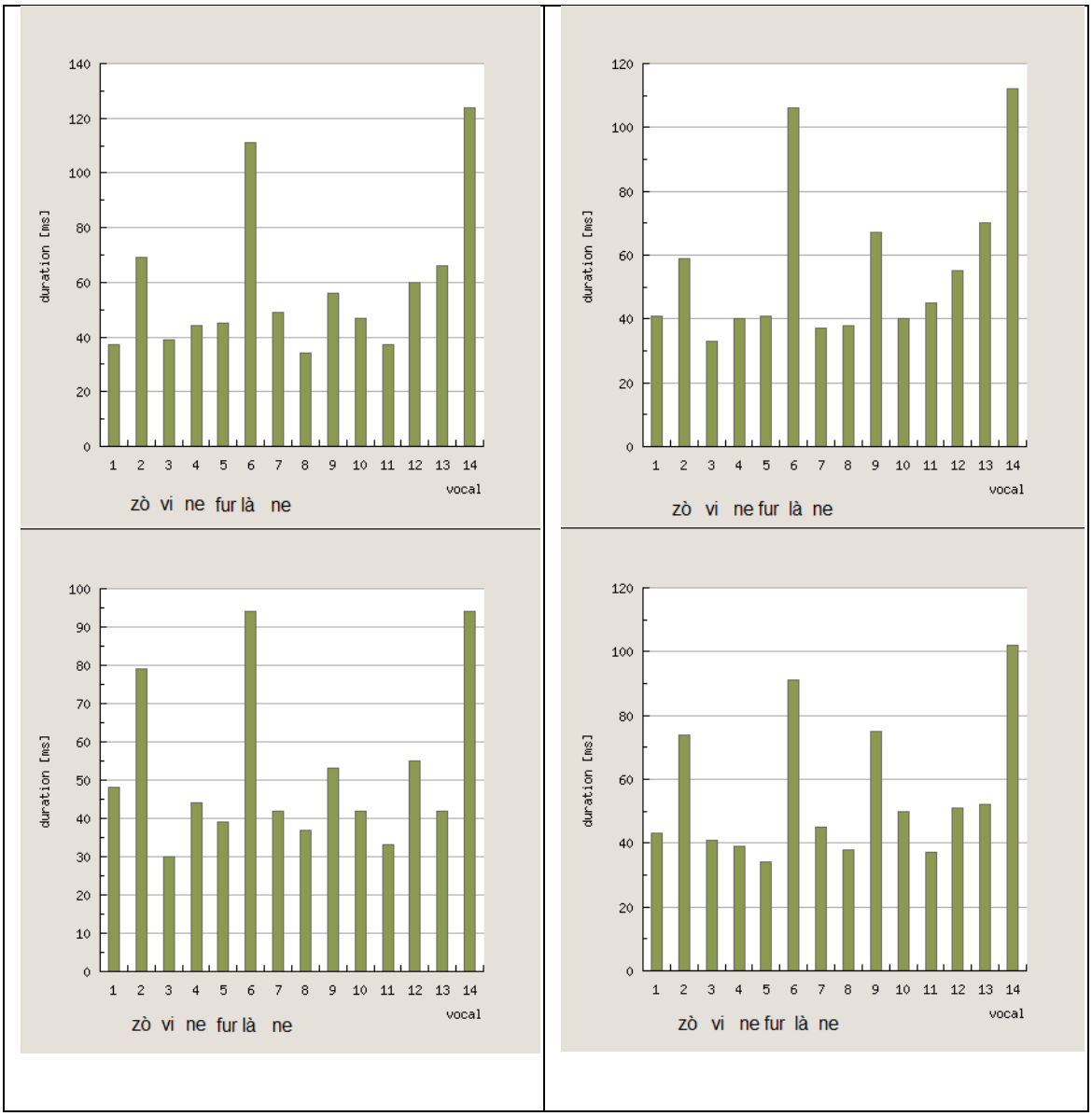


Figure 6: Vowel length graphs of stress positions without clash in the NP3 of declaratives (left) and interrogatives (right) of male voices (below) and female voices

[2] For greater clarity, in the transcription of the Fiulian sentences, we have decided to mark with a tilde the position of the lexical stress also when the orthographic rules of that language do not prescribe it.

(above) from Beivars. The graphs correspond to the sentences *La ghitàre si sùne cun dolcèce splèndide* and *La ghitàre si sùnie cun dolcèce splèndide?*

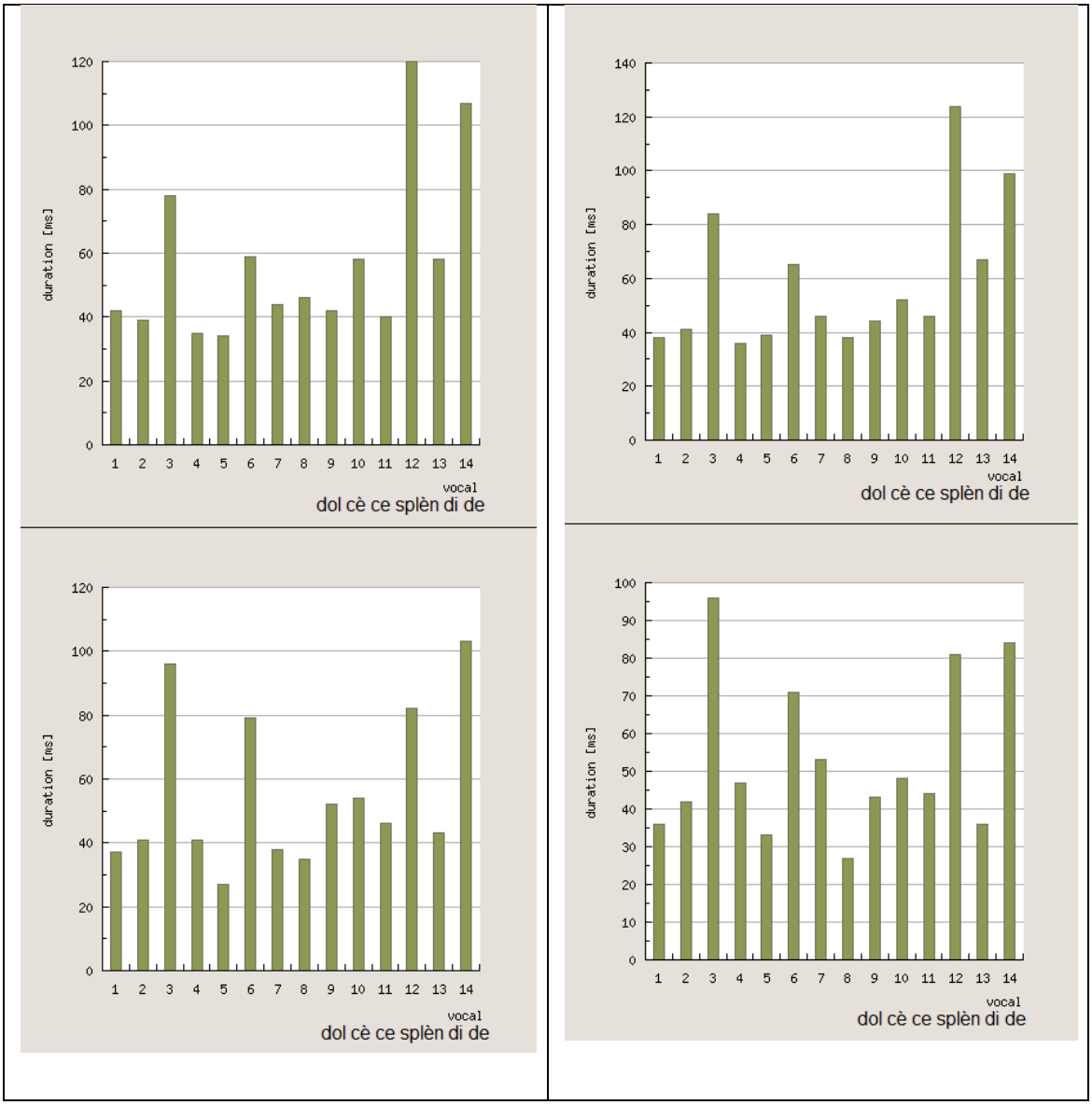


Figure 7: Vowel length graphs of stress positions with clash in the NP1 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Beivars. The graphs correspond to the sentences *La sorestànt zòvine si sìnte sul savalòn* and *La sorestànt zòvine si sìntie sul savalòn?*

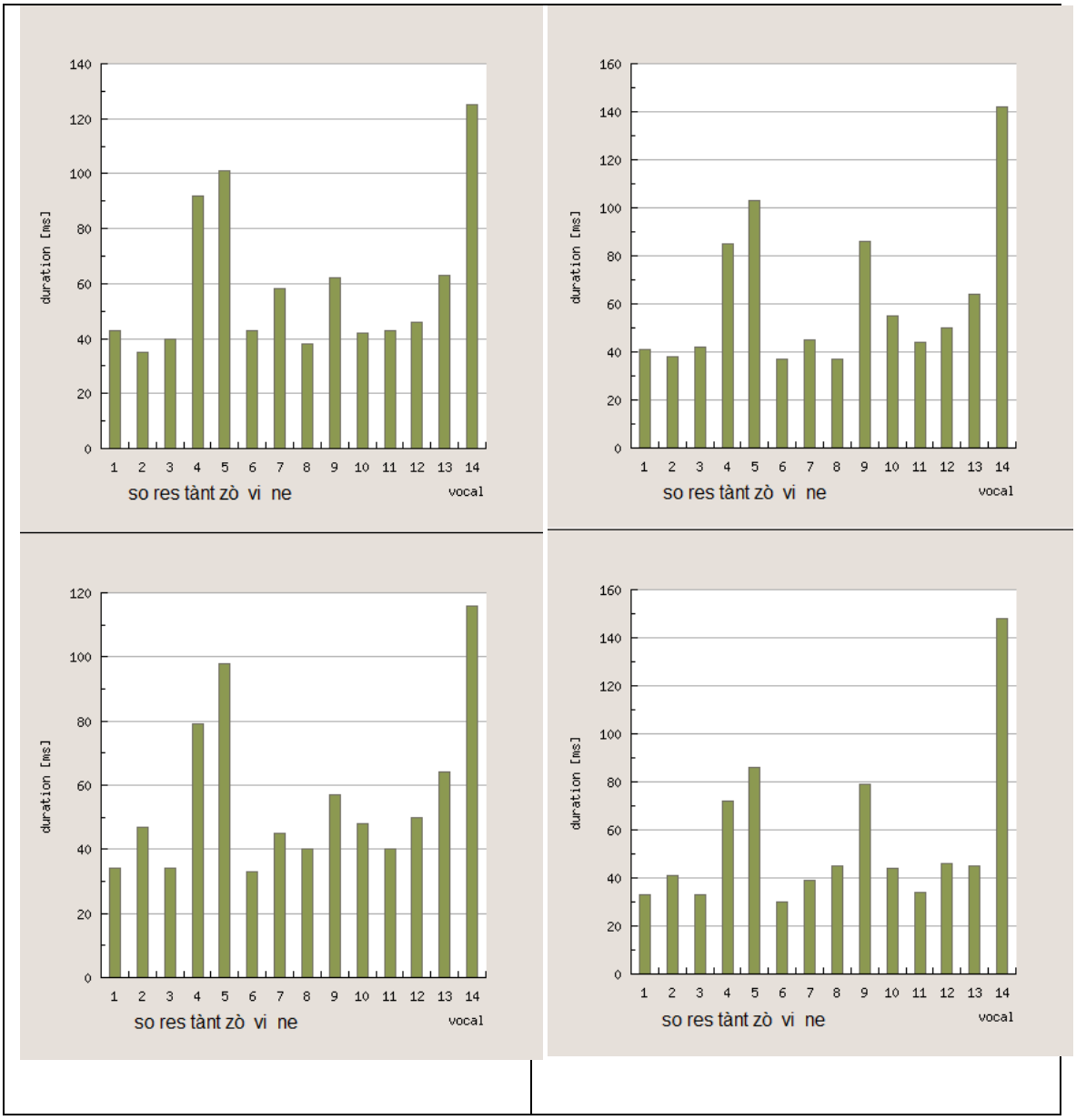
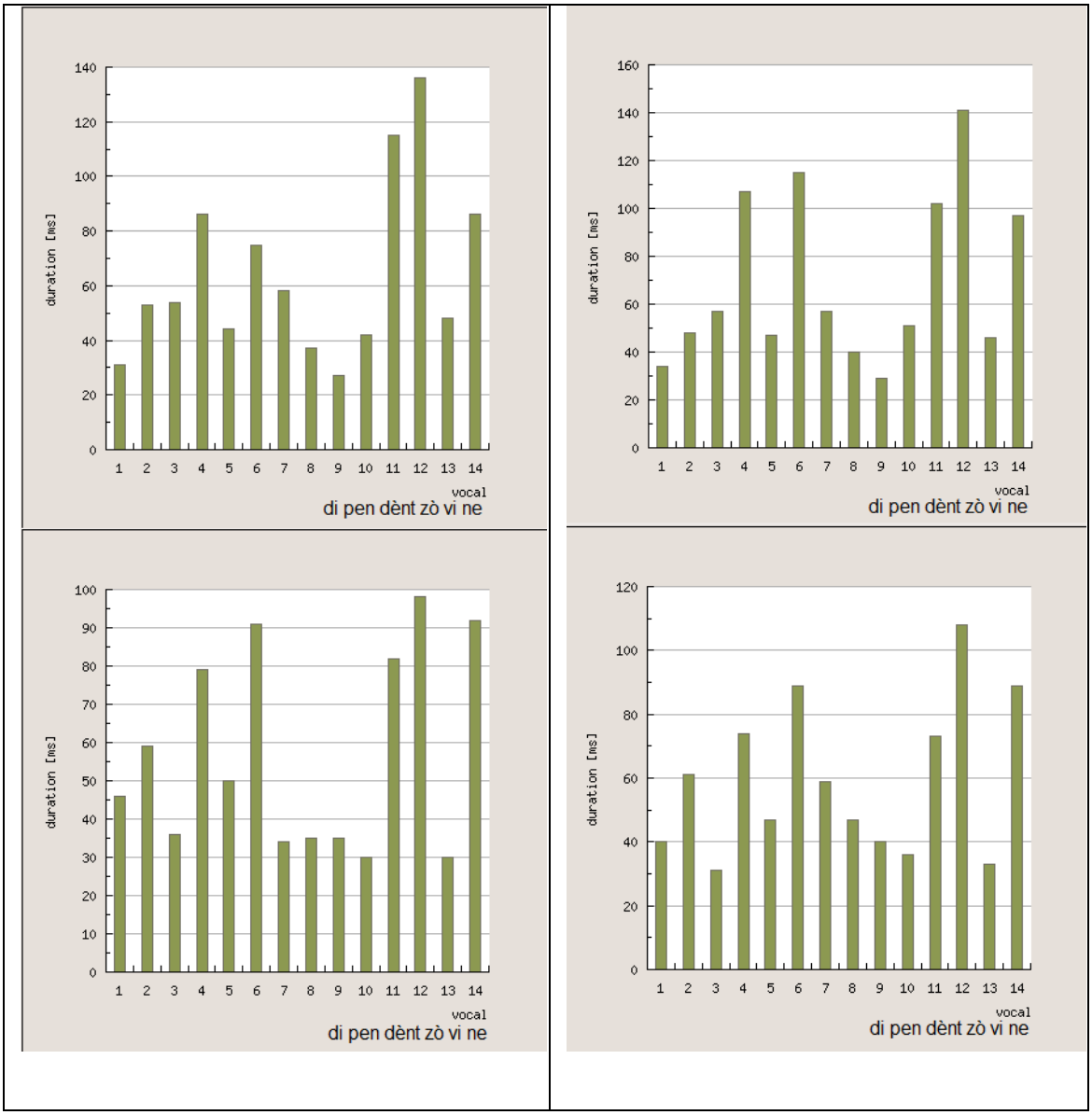


Figure 8: Vowel length graphs of stress positions with clash in the NP3 of declaratives (left) and interrogatives (right) of male voices (below) and female voices (above) from Beivars. The graphs correspond to the sentences *El sorestànt si cjàle la dipendènt zòvine* and *El sorestànt si cjàlial la dipendènt zòvine?*



3.2. Loudness

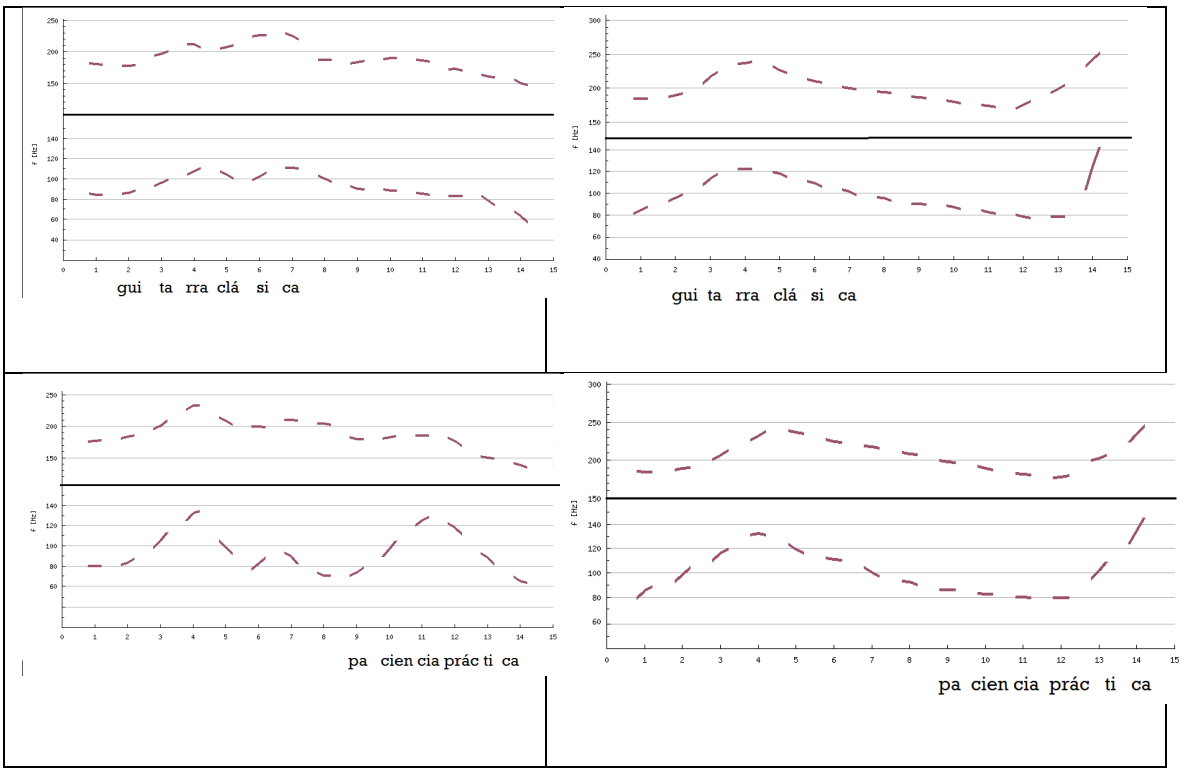
Loudness is not an acoustic correlate of stress in any of the three languages (tables 2-a and 2-b for Spanish, table 6 for Catalan, and tables 10-a and 10-b for Friulian). In Spanish, as a general rule, differences come under threshold, but when there is one over the threshold, these cases appear in contradictory positions; for example, differences between the pretonic and tonic syllable of NP1 in statements in clash position are over threshold, but in the same positions in NP3, they are under threshold. If loudness were

functional, it would have to display the same pattern in NP1 as in NP3, and in both sentence types, declarative and interrogative. The difference between the tonic syllable in the Expansion and the posttonic syllable in NP1 and NP3 in clash situations is positive in declaratives and negative in interrogatives. This is a contradiction that would not happen if length were functional; the difference would be positive in all cases. The same happens in Catalan and Friulian, as can be seen in the corresponding tables.

3.3. Fundamental Frequency (F0)

3.3.1. Spanish

Figure 9: Intonation contours of stress positions without clash of declaratives and interrogatives of male voices (below) and female voices (above) from Madrid.



As evidenced by the graphs in Figure 9, in the NP1 of declaratives the peak appears in the posttonic syllable when the words are paroxytonic, here *guitarra*, but in

proparoxytonic words, the peak is located in the postposttonic syllable, as can be seen in *clásica*, where the syllable *-ca* is higher, that is, the peak tends to be on the last syllable of the word. In NP3, the peak again appears in the posttonic syllable in *paciencia*, but since *práctica* is the last word of the statement, the peak is actually the continuation of the previous syllable, and there is a gradual fall at the end. In the interrogative, the situation changes completely, as the sentence type contour dominates. In this case there is only one initial peak, located on the posttonic syllable of NP1, and there is a gradual fall leading to the last stressed syllable, where the final rise begins. This is why the fall continues in the NP3 in *paciencia*, while the classic rise of the Spanish yes/no question starts in *práctica*. It is clear that the fundamental frequency is subject to sentence type requirements more so than to those of stress, since in interrogatives, the only peak that stands out is the initial one in NP1, located on the posttonic syllable.

Figure 10: Intonation contours of stress positions with clash of declaratives and interrogatives of male voices (below) and female voices (above) from Madrid.

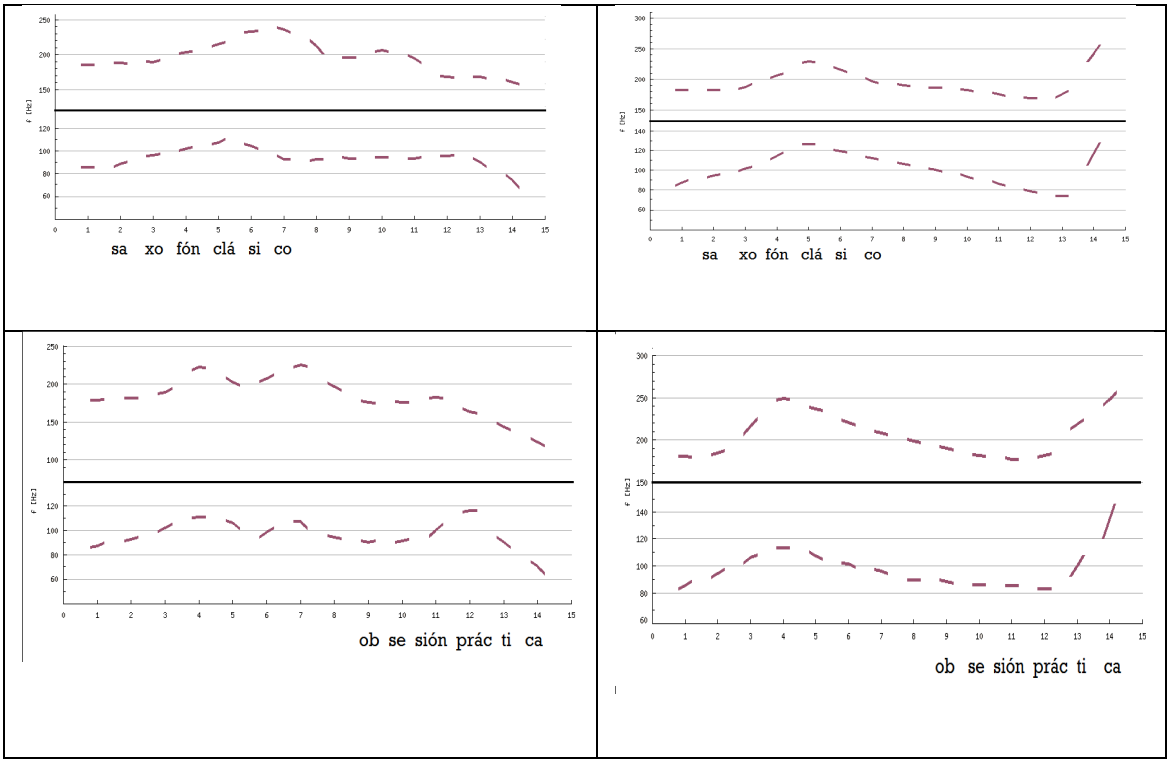
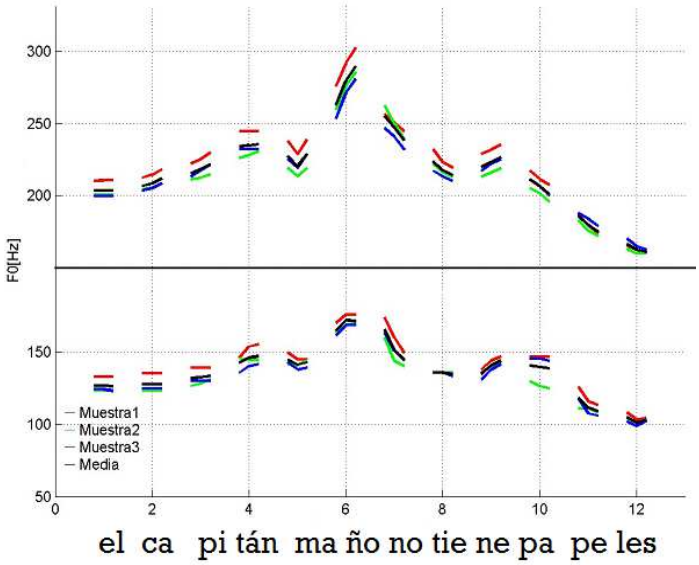


Figure 10 shows that the clash does not have a special effect on the intonation contour, nor on the F0 of words. In the declarative sentences, the initial syllable of *clásico* is the posttonic syllable of the last syllable of *saxofón*, therefore it is logical that it would be the peak of NP1, as the *-rra* in *guitarra* is in the previous figure. In other words, the peak on the *clá-* of *clásico* is not due to the stress of that syllable, but to the influence of the previous syllable that transfers the peak to the posttonic syllable; in fact, this is clear in the declarative of the female voice where the peak caused by the proparoxytonic word is transferred to the postposttonic syllable, as was attested in the no-clash position. In interrogatives, the peak of the NP1 is located again on the *clá-* syllable as it was before on the *-rra*: the same prosodic position. From here, there is a gradual fall until the last word. In the NP3 of interrogatives, the contours of the male and female voices present some differences, because in the male voice, the peak is on *prác-*, while in the female voice it is on *-sión*. In the case of the male voice, the argument would be the same: there is a transfer of the peak to the posttonic syllable, even if that syllable is the next word's tonic syllable, as in the case of clash. The interrogative with clash behaves exactly the same as the interrogative without clash: there is a gradual fall leading to the last word, where the typical rise of yes/no questions begins.

Even though it does not belong to the corpus of AMPER, we wanted to test what happens when the second word of the clash is paroxytonic. In these cases, the peak is transferred to the posttonic syllable of the paroxytonic word, as happens as a general rule, and the oxytonic word maintains its peak on the tonic syllable (Figure 11). Hence, the clash is not avoided since there will never be two adjacent peaks because of the

regular shift of the peak to subsequent syllables and because of the possibility of maintaining the peak on the stressed syllable of oxytonic words.

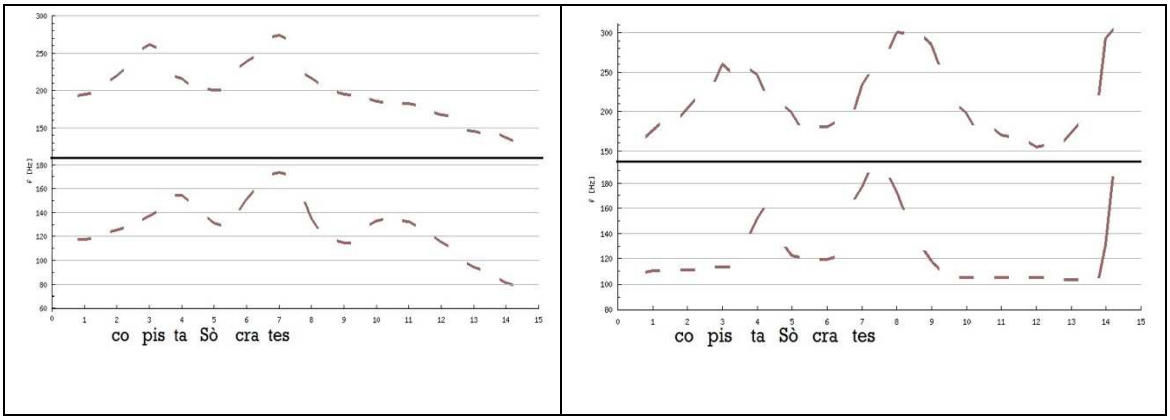
Figure 11: Clash between adjacent oxytonic and paroxytonic words in NP1. Three repetitions and the mean are represented in a male voice (below) and female voice (above) of speakers from Barcelona.



The conclusion, then, is that there is no strategy to avoid the stress clash and the intonational schemes maintain the patterns established by sentence type. Clash situations and no-clash situations behave in the same way.

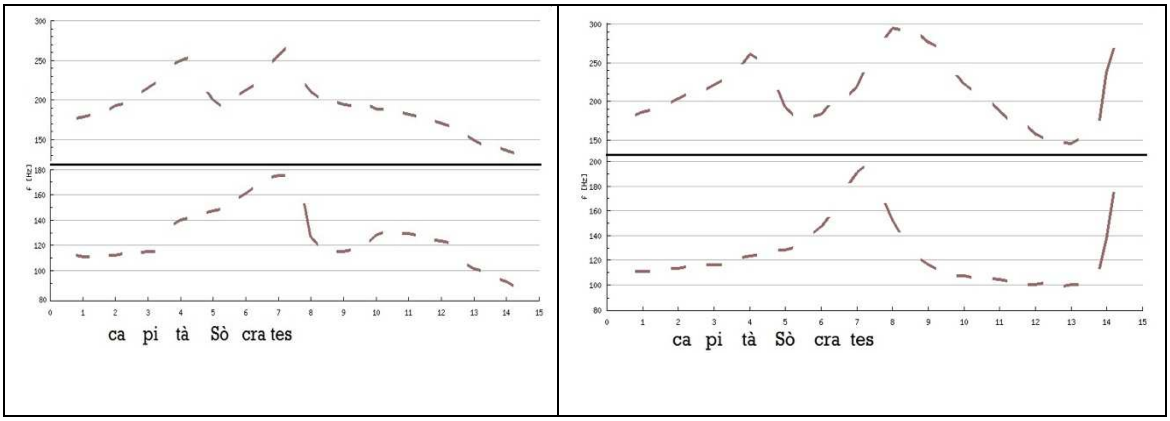
3.3.2. Catalan

Figure 12: Intonation contours of stress positions without clash in declaratives and interrogatives, male voices (below) and female voices (above) of the Catalan from Barcelona.



First, we must highlight the differences between the contour of the male voice and the female voice (Figure 12). As expected, the first peak happens on the posttonic syllable of *copista* and the second one on the postposttonic of *Sòcrates*, both in the declarative and in the interrogative sentences pronounced by a male voice. This is the same behavior observed in Spanish. In contrast, in the contour of the female voice, the first peak is located on the stressed syllable in both sentence types, and the second peak is further set back in the interrogative sentence, where the question really begins after NP1, as if what was said were: *El copista Sòcrates, no ocupa la càtedra?*, which explains the change in the normal neutral intonation. Therefore, the contour of the male voice is more reliable, since it follows the normal patterns described for Catalan from Barcelona.

Figure 13: Intonation contours of stress positions with clash in declaratives and interrogatives, male voices (below) and female voices (above) of the Catalan from Barcelona.

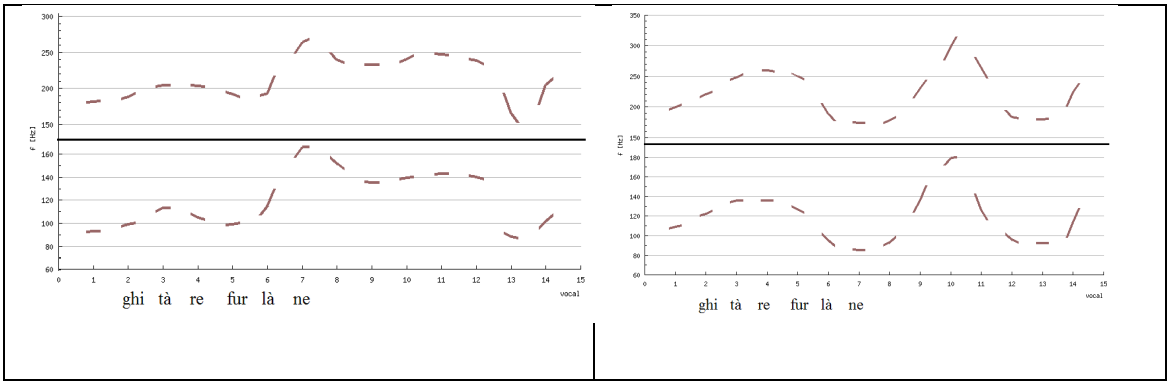


Once again, there are differences between the contours of the male voice and the female voice in stress clash situations. In the female contour, the first peak appears on the stressed syllable of *capità* and the second on the posttonic of *Sòcrates*, where it introduces a fall after the first stress. In the interrogative it follows the same strategy as in the no-clash contour: placing the second peak on the *no* that follows *Sòcrates*. Therefore, it appears that Catalan also does not use any strategies to avoid stress clash. In all cases the pitch rises both in the first stressed syllable, with a peak in the female voice, and in the postposttonic of *Sòcrates*. In the interrogative of the female voice, this rise continues until the end of the word. Both in Spanish and in Catalan, the proparoxytonic word tends to set back the peak to the postposttonic syllable, which licenses the peak of the first stressed syllable without issue. This prevents the clash from truly happening. The clash would only actually occur if both tonic syllables had to have their own peak, which is not the case with proparoxytonic words in general. There is only one slight difference to highlight between Spanish and Catalan, particularly in interrogatives. In Spanish there is only one initial peak that is usually located on the posttonic syllable of the first lexical word of NP1, while in Catalan either there are two peaks, or the initial peak is transferred to the expansion of NP1.

3.3.3. Friulian

In Friulian, when the subject of declarative sentences is formed by two stressed words (for instance, *la ghitàre furlàne*), the intonation is characterized by a first tonal peak in the first stressed syllable. Then, F0 falls towards the second stressed syllable of the noun phrase, then rises towards the posttonic syllable, that is, the end of the noun phrase. In interrogative sentences with the same stress structure, the first tonal peak is located on the first stressed syllable. Then, F0 falls sharply towards the second stressed syllable, to then stay low until the end of the noun phrase (Figure 14).

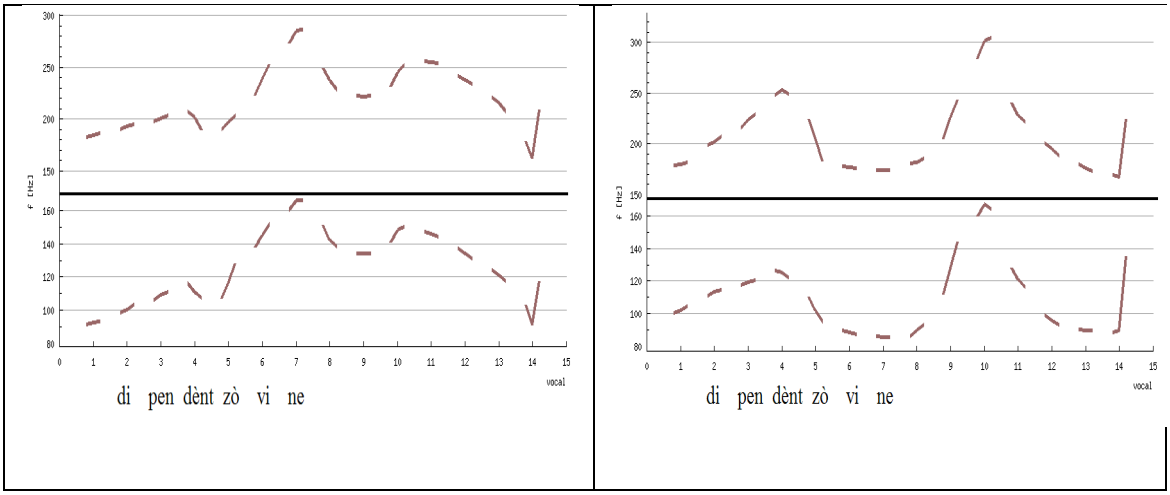
Figure 14: Intonation contours of stress positions without clash in the NP1 of declaratives (left) and interrogatives (right), male voices (below) and female voices (above) of the Friulian from Beivars. The graphs correspond to the sentences *La ghitàre furlàne si sùne cun dolcèce* and *La ghitàre furlàne si sùnie cun dolcèce?*



In the cases of stress clash in NP1 between an oxytonic and a proparoxytonic word, as in the noun phrase *La dipendènt zòvine* (Figure 15), in declarative sentences the second stress, that is, the rise that starts on the stressed syllable *zò-* remains unaltered. The first tonal stress, which in the canonical situation –or without clash—is realized as a rise of F0 with a peak on the tonic syllable, in clash situations is realized with the peak on the pretonic syllable. In other words, the stress clash causes the first peak to retract from the tonic to the pretonic syllable. In the case of interrogative sentences, no difference is seen

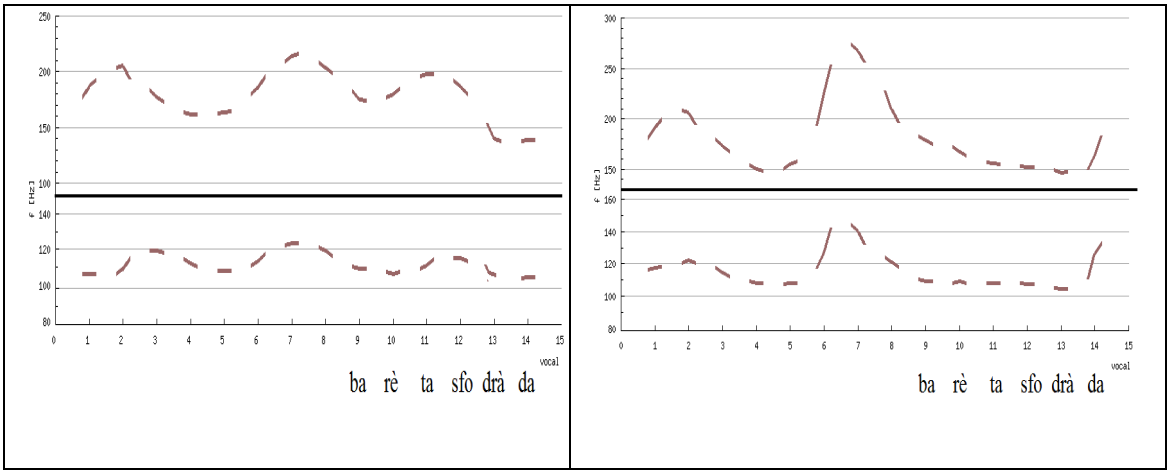
from the canonical situation: the first tonal peak is located on the first stressed syllable and, then, F0 falls towards the second stressed syllable of the noun phrase.

Figure 15: Intonation contours of stress positions with clash in the NP1 of declaratives (left) and interrogatives (right), male voices (below) and female voices (above) of the Friulian from Beivars. The graphs correspond to the sentences *La dipendènt zòvine si sìnte sul savalòn and La dipendènt zòvine si sìntie sul savalòn?*



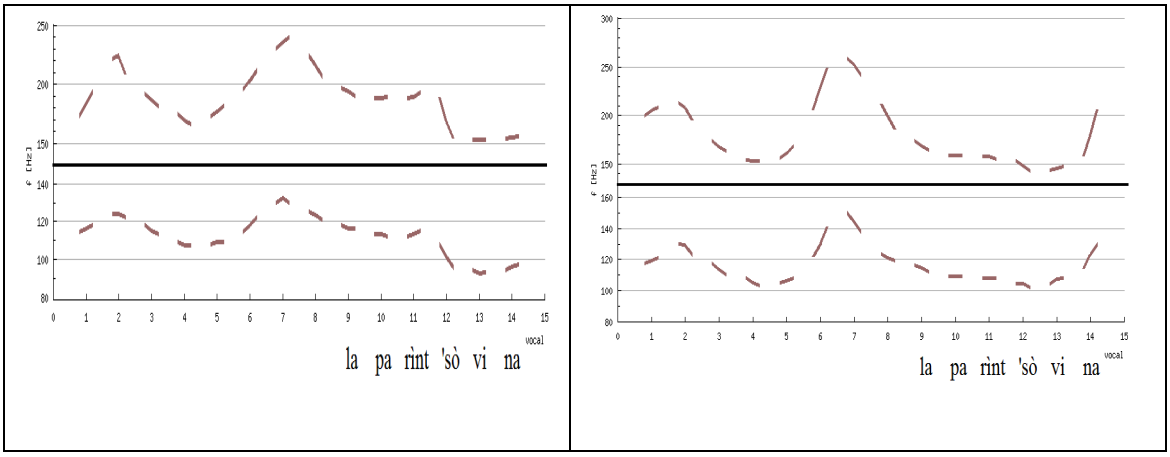
If the object noun phrase is composed of two words (for instance, *la barèta sfodràda*), canonically the intonation of declarative sentences is characterized by a peak on the first posttonic syllable. Then, F0 falls until the end of the next stressed syllable, the last one in the sentence. In interrogative sentences, F0 stays low throughout both stressed syllables of the noun phrase and rises in the final posttonic syllables, as can be seen in Figure 16.

Figure 16: Intonation contours of stress positions without clash in the NP3 of declaratives (left) and interrogatives (right), male voices (below) and female voices (above) of the Friulian from Tesis. The graphs correspond to the sentences *La ’sòvina si pròva la barèta sfodràda and La ’sòvina si pròve la barèta sfodràda?*



In the cases of stress clash in the object noun phrase, like the one produced in the phrase *la parìnt ‘sòvina*, in interrogative sentences, there is no difference compared to the canonical situation, that is, both stressed syllables are realized with low pitch, as can be observed in figure 9. In declarative sentences, the canonical peak is realized on the posttonic syllable, while in stress clash situations, it is realized on the tonic syllable.

Figure 17: Intonation contours of stress positions with clash in the NP3 of declaratives (left) and interrogatives (right), male voices (below) and female voices (above) of the Friulian from Tesis. The graphs correspond to the sentences *La fèmina si fèrma cu la parìnt ’sòvina* and *La fèmina si fèrme cu la parìnt ’sòvina?*



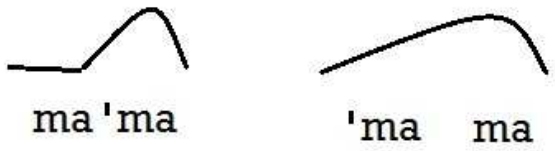
4. Discussion

Several experiments have been carried out regarding the stress clash in Spanish, not only from the Peninsula, but also from the Canary Islands and Latin America, specifically, Argentina and Chile. One of the first experiments was done by Pamies (1994), who states that "*se concluye que existe un indudable debilitamiento acústico de uno de ellos…*" [there exists a decided acoustic weakening of one of them…] (p. 93), referring to one of the two adjacent stresses, for him, it is the first one that becomes weakened. A few years later, Toledo (1998) studies the phenomen in Argentina and concludes that "*los resultados generales no mostraron una tendencia a evitar el choque acentual…*" [the general results do not show a tendency to avoid the stress clash…] and adds that "*desde el punto de vista fonético, no se observó un debilitamiento de uno de los miembros del par acentual*" [from the phonetic standpoint, there was no observable weakening of either member of the stress pair] (p. 217). The latter statement constitutes a counterargument to Pamies's opinion. Soon after that, Almeida & San Juan (2001) studied the matter in the Canary Islands. They conducted research to see if there is stress retraction as it does in compound names: *Miguel Ángel* [ˈmigeˈlaŋxel], for instance, where the stress is transferred to the pretonic syllable in Miguel; but they do not find it in other syntactic structures. They clearly state that "*se esperaba que si existía algún tipo de vestigio de retracción del acento, los índices prosódicos de la sílaba átona de papá alcanzarían valores más altos… en una situación de clash…*" [it was expected that if there was any kind of trace of stress retraction, the prosodic indexes of the unstressed syllable of *papá* would reach higher values… in a clash situation…] (p.165). But they did not find any such retraction. Instead, the "*hablantes tienden a mantener los acentos léxicos… no a debilitarlos*" [speakers tend to maintain lexical stresses… not to weaken

them] (p. 168). Dorta & Hernández (2007) again studied the matter of stress clash in the Canary Islands, using the AMPER corpus, and their conclusion is the same as Alemida & San Juan: "*no se rechaza el choque acentual en ninguna de las variables consideradas*" [the stress clash is not rejected in any of the variables analyzed] (p. 121). Finally, Atria (2009) echoes a statement made by Prieto et al. (1995), who had published a study based on Mexican speakers, and says that "*la realización del par de sílabas en choque [se lleva a cabo] con un gesto tonal compuesto de solo un pico de F0, en oposición a la esperada aparición de dos picos debido a la presencia de dos acentos. Según dicho artículo, la primera sílaba acentuada marcaría un ascenso de la frecuencia fundamental, mientras que la segunda constituiría el descenso tonal…*" [the realization of the pair of clashing syllables [is carried out] with a tonal gesture composed of a single F0 peak, as opposed to the expected appearance of two peaks due to the presence of two stresses. According to this article, the first stressed syllable would indicate a rise in fundamental frequency, while the second one would constitute a tonal fall…] (Atria 2009 14). This author states that "*la realización de un pico tonal único prima por completo en las oraciones con choques acentuales*" [the realization of a single tonal peak takes utmost precedence in sentences with stress clashes] (p. 27). Nonetheless, he is somewhat perplexed because he claims to have found the same strategy in no-clash situations. What happens is that he uses sentences that are exceedingly short with a structure of NP+V: *su mamá mata* vs. *su mama mata* (see Atria 2009, figure 7). In both cases there is a single tonal peak, in the latter because there is a transfer of the peak to the posttonic syllable, as usual, and in the former there is no such transfer, the peak is realized on the tonic syllable, which again renders a single peak. However, it is important to take into account that the last word is a nucleus, and shows a gradual fall in both cases. He should have used longer sentences to see if

the second stressed syllable also transfers its peak to the posttonic syllable; for instance: *su mamá mata conejos en el campo*. Another aspect that he fails to comment on is the palpable difference between the pretonic syllable of *mamá* [ma□ma] and the tonic syllable in *mama* [□mama]: the former is flat, while the latter is rising, which indicates that, although the peak is in the same position, the different slope of the syllable preceding the peak shows if it is unstressed or stressed, as can be seen in figure 18.

Figure 18: Stress structure of *mamá* and *mama*.



Clearly, we agree with Toledo (1998), Almeida & San Juan (2001) and Dorta & Hernández (2007). We have not found any strategy that avoids the stress clash. In no case is there a retraction or a weakening of either of the two stresses. We also disagree with Atria in that the chief strategy is of a single peak, as has also been found by Prieto *et al.* (1995). Our main contribution in front of all of these studies is having studied the clash considering two sentence types and two positions in the sentence. This brings a greater richness to the study of clashes. For instance, we found a single peak, as defended by Atria, but not only in the clashes, we found it in the NP1 of yes/no questions. This, however, is not due to the effect of stresses, but rather to the typical configuration of the contour of information-seeking yes/no questions.

In Catalan, the focal study dedicated to stress clash is Prieto et al. (2011) and their conclusion is as follows: *"L'anàlisi dels patrons d'entonació, en canvi, indica que les*

síl·labes en situació de xoc tendeixen a 'desaccentuar-se' tonalment, és a dir, presenten un moviment tonal descendent […] *en català el correlat acústic més fiable de la desaccentuació en xocs accentuals és la davallada del to*" [The analysis of the intonation patterns shows, in contrast, that the syllables in clash situation tend to 'de-stress' tonally, that is, show falling tonal movement […] in Catalan, the most reliable acoustic correlate of de-stressing in stress clashes is the fall in pitch] (p. 32). Our data do not corroborate these statements. The means of F0 found in speakers are reflected in tables 7 and 8: in the male voice, declarative sentences show the two stressed syllables of the clash at values of 110-120 Hz with the difference coming over threshold, however slightly (1.51 st), and it is statistically significant. In this case, it could be claimed that the first syllable of the clash is de-stressed, but the same male voice in yes/no questions renders values of 119-116 Hz with difference under threshold and not statistically significant (0.63); therefore, both stresses are maintained. In the female voice we find values of 256-252 Hz (0.27 st and 0.66 in T-test) in declaratives and 265-240 in interrogatives (1.71 st and 0.12 in T-test). In both cases, the T-text renders non-significant differences, even though in interrogatives, the difference is considerable and appears over threshold. But if the strategy were always a fall in pitch, as is claimed by Prieto *et al.*, it would have to be a systematic feature in all speakers and all sentence types, and we have proven than this is not the case. Additionally, in Prieto et al.'s graphs (2001, 30) of the phrase *El nen blac de Granollers* [The white boy from Granollers], it is the first stress, the one on *nen* that is much lower in pitch; thus, it would be the first syllable of the clash, which only happens in the declarative of the male voice and not in any other case. Language tends to be systematic in the fundamentally distinctive features, so we would have had to find the same pattern in both sentence types and in both male and female voices to agree with the claims of

Prieto *et al*., but it has not been so, and our conclusion is that both syllables are maintained and the stress clash is not avoided.

The analysis of the data from Friulian, for which there are no prior studies about the resolution of stress clash, shows that this language on the one hand, keeps length as an acoustic correlate of lexical stress also in clash situations and, on the other, applies the stress retraction strategy described classically for several other languages like English (Bruce 1983), Dutch (van Heuven 1987), Brazilian Portuguese (Major 1985), and Italian (Nespor & Vogel 1979), but only in the NP1 of declaratives, since in interrogatives the pretonic syllable is generally lower and rises towards the first tonic syllable that becomes the first peak followed by a gradual fall until the last stress, where the final rise begins. In the NP3, declaratives show a gradual fall in clash situations; however, in no-clash situations, declaratives present a fall from the pretonic to the tonic syllable, but the posttonic syllable begins a rise that ends in the next stress, where the final fall begins. In interrogatives there is a slight rise in the posttonic syllable, but the next syllable falls.

The general conclusion is that in clash situations in NP1 for Friulian is that, as a general rule, both stresses are maintained on their respective tonic syllables and that, therefore, the contour prescribed by sentence type is followed. This is so, even though in declaratives there is a retraction and the peak is transferred to the pretonic syllable, but the differences in F0 between pretonic and tonic syllables are not often over threshold nor are they statistically significant. It is, however, true that that in the NP1 of declaraties in clash situations, the frequency of the pretonic syllable is always higher than the tonic one, while when there is no clash, the frequency of the pretonic is always

lower. In the NP3, according to sentence type, the pretonic is always higher because there is a gradual fall when there is a stress clash, but this is set apart from the no-clash situation because the posttonic syllable is always rising.

5. Conclusions

The main conclusion is that neither Spanish nor Catalan avoid stress clash. The key parameter that carries stress is F0; loudness and length do not show differences over threshold, and therefore cannot be considered functional or distinctive parameters for stress. It seems clear that intonation, whose key parameter is F0, is dictated, predominantly, by sentence type. It seems that intonation, far from de-stressing the first syllable of a clash, makes this syllable govern the tonal pattern at the expense of what comes after it, both when the syllable that follows is stressed or unstressed. There is another possible interpretation: sentence type imposes its pattern to the lexical stresses that compose the sentence, and these cannot but subscribe to the general intonational mold. In other words, firstly, in NP1, if the peak is transferred to the posttonic syllable, it will do so both in clash and no-clash situations, it is simply that in this case, the posttonic syllable is the tonic syllable of the next word. And secondly, in NP1, there will normally be two peaks in declarative sentences, with the second on the posttonic syllable of a proparoxytonic word, and a single peak, in Spanish yes/no questions. In this case, the peak appears in the posttonic syllable of NP1, whether it is unstressed in no-clash situation, or stressed in clash situation. In NP3 the predominant pattern is the one dictated by sentence type, gradual fall in declaratives and a rise starting on the tonic syllable of the last word in interrogatives.

The study of Friulian has helped to strengthen our conclusions about Catalan and Spanish. Friulian uses length as a stress-supporting parameter and, additionally, there is stress retraction in intonation, with a pitch rise in the pretonic syllable of the first stress that clashes, although this is only true in the NP1 of declaratives. These phenomena are foreign to the other two languages.

References

Almeida, Manuel and Esteban San Juan. 2001. "Clash silábico y desplazamiento acentual en español." *Estudios de Fonética Experimental* 11: 159-171.

Atria Lemaitre, José Joaquín. 2009. "Estrategias de resolución de choques acentuales en el castellano hablado en Santiago de Chile." *Onomázein* 19(1): 11-31.

Bruce, Gösta. 1983. "On rhythmic alternation." *Working Papers of the Department of Linguistics and Phonetics, Lund University* 25: 35-52.

Contini, Michel, Jean-Pierre Lai, Antonio Romano, Stefania Roullet, Lurdes de Castro Moutinho, Rosa Lídia Coimbra, Urbana Pereira Bendiha and Suzana Secca Ruivo. 2002. "Un projet d'Atlas Multimédia Prosodique de l'Espace Roman." In *Speech Prosody 2002*, ed. by Bernard Bel and Isabelle Marlien, 227-230. Aix-en-Provence: Laboratoire Parole et Langage, CNRS / Université de Provence.

Contini, Michel. 2005. "2e Séminaire international du projet AMPER." *Géolinguistique* Hors Série n.3 : 1-11.

Dorta, Josefa and Beatriz Hernández. 2007. "El choque de acentos en español." *Síntesis Tecnológica* 3(2): 111-123.

Elvira García, Wendy and Eugenio Martínez Celdrán. Submitted. “El umbral de intensidad en español.”

Fernández Planas, Ana Maria and Eugenio Martínez Celdrán. 2007. “Aspects metodològics del projecte AMPER a Espanya.” In *Actes del Catorzè Col·loqui Lingüístic de la Universitat de Barcelona: Aplicacions de la fonètica*, ed. by JosefinaCarrera and Clàudia Pons, 187-198. Barcelona: PPU.

Fernández Planas, Ana Maria. 2005. “Aspectos generales acerca del proyecto internacional AMPER en España.” *Estudios de Fonética Experimental* 14: 13-27.

Garrido, Juan María, Joaquim Llisterri, Carme de la Mota and Antonio Ríos. 1993. “Prosodic differences in reading style: Isolated vs. contextualized sentences.” In *Eurospeech 1993. Proceedings of the 3rd European Conference on Speech Communication and Technology*, Vol. 1, 573-576. Berlin.

Llisterri, Joaquim, María Jesús Machuca, Carme de la Mota, Montserrat Riera and Antonio Ríos. 2003. “Algunas cuestiones en torno al desplazamiento acentual en español.” In *La tonía: dimensiones fonéticas y fonológicas*, ed. by Esther Herrera Z. and Pedro Martín Butragueño, 163-185. México: El Colegio de México.

López Bobo, María Jesús, Camen Muñiz Cachón, Liliana Díaz Gómez, Norberto Corral Blanco, David Brezmes Alonso and Mercedes Alvarellos Pedrero. 2007. “Análisis y representación de la entonación: Replanteamiento metodológico en el marco del proyecto AMPER.” in *La prosodia en el ámbito lingüístico románico*, ed. by Josefa Dorta and Beatriz Fernández, 17-34. Madrid: La Página Ediciones.

Major, Roy C. 1985. “Stress and rhythm in Brazilian Portuguese.” *Language* 61: 259-282.

Navarro Tomás, Tomás. 1918(1971). *Manual de pronunciación española*. Madrid: CSIC.

Nespor, Marina and Irene Vogel. 1979. “Clash avoidance in Italian.” *Linguistic Inquiry* 10: 467-482.

Pamies Bertrán, Antonio and Ana Maria Fernández Planas. 2006. “Sobre la percepción de la duración vocálica en español.” In *Actas del V Congreso Andaluz de Lingüística General*, ed. by Juan de Dios Luque Durán, 501-512. Granada: Granada Lingvistica.

Pamies Bertrán, Antonio, Ana Maria Fernández Planas, Eugenio Martínez Celdrán, Alicia Ortega Escandell and Mª Cruz Amorós Céspedes. 2002. “Umbrales tonales en el español peninsular.” In *Actas del II Congreso de Fonética Experimental*, ed. by Jesús Díaz García, 272-278. Sevilla: Laboratorio de Fonética, Facultad de Filología, Universidad de Sevilla.

Pamies, Antonio. 1994. “Los acentos contiguos en español.” *Estudios de Fonética Experimental* 6: 91-111.

Prieto, Pilar, Jan van Santen and Julia Hirschberg. 1995. “Pitch Downtrend in Spanish.” *Journal of Phonetics* 23: 445-473.

Prieto, Pilar, Salvador Oliva, Blanca Palmada, Pep Serra, Beatriz Blecua, Silvia Llach Victòria Oliva. 2001. “Anàlisi acústica de la resolución de xocs accentuals en català.” *Estudios de Fonética Experimental* 11: 11-40.

Quilis, Antonio. 1993. *Tratado de fonología y fonética españolas.* Madrid: Gredos.

Romito, Luciano and Lorenzi Marcella Giulia. 1997. “Considerazioni generali sul comportamento di alcune varietà dialettali meridionali e settentrionali rispetto

all'accento intensivo." *Quaderni Del Dipartimento di lingüística dell'Università della Calábria, Serie Linguistica* 6: 11-34.

Roseano, Paolo and Ana Maria Fernández Planas. 2013. "L'intonazione delle dichiarative neutre e delle interrogative polari in quattro varietà friulane: Agrons, Beivars, Tesis e Gradisca d'Isonzo." *Ladinia* 37: 161-182.

Roullet, Stephanie. 1999. "Accent et intonation dans le parler de deux villages valdôtains : Sarre et Cogne." *Géolinguistique* 8: 197-235.

Toledo, Guillermo. 1998. "Prominencia melódica y temporal: La colisión acentual en español." *Estudios de Fonética Experimental* 9: 201-220.

van Heuven, Vincent J. 1987. "Stress Patterns in Dutch (Compound) Adjectives: Acoustic Measurements and Perception Data." *Phonetica* 44: 1-12.

ANNEX 1

SPANISH

Length (ms)	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	45	67			62	40
T-test-u	,00 +u	,00 -u				,00 +u
D-SC	52	60	50	58	66	40
T-test-u	,00 -u	,00 -u		,00 -u		,00 +u
I-CC	50	58			62	42
T-test-u	,00 -u	,00 -u				,00 +u
I-SC	49	54	50	57	61	40
T-test-u	,00 -u	,00 -u		,00 -u		,00 +u

Table 1-a: length means in Spanish NP1 (where CC=with clash and SC=withouth clash; ‘u’= threshold; D=declarative and I=Interrogative)

Length (ms)	Preton NP3	Tonica NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	47	77			65	41
T-test-u	,00 +u	,01 -u				,00 +u
D-SC	53	84	68	57	72	57

T-test-u	,00 +u		,00 -u		,00 -u	,00 -u
I-CC	48	68			57	45
T-test-u	,00 +u		,00 -u			,00 -u
I-SC	55	81	76	59	77	66
T-test-u	,00 +u		,02 -u		,00 -u	,00 -u

Table 1-b: length means in Spanish NP3.

Loudness (dB)	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	94	100			100	95
T-test-u	,00 +u		1,00 -u			,00 +u
D-SC	97	101	100	99	99	95
T-test-u	,00 -u		,00 -u		,00 -u	,00 -u
I-CC	95	102			100	97
T-test-u	,00 +u		,04 -u			,03 -u

I-SC	96	100	99	100	98	95
T-test-u	,00 -u		,03 -u	,00 -u		,00 -u

Table 2-a: loudness means in Spanish NP1.

Louness (dB)	Preton NP3	Tonica NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	93	98			96	90
T-test-u	,00 -u		,01 -u			,00 +u
D-SC	95	96	93	97	95	90
T-test-u	,00 -u		,00 -u	,00 -u		,00 +u
I-CC	93	97			95	94
T-test-u	,00 -u		,19 -u			,14 -u
I-SC	95	95	95	95	95	94
T-test-u	,06 -u		,08 -u	,21 -u		,02 -u

Table 2-b: loudness means in Spanish NP3.

F0 (Hz) Male	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	112	125			134	145
T-test-u	,00 +u	,00 -u			,00 -u	
D-SC	108	127	136	125	129	131
T-test-u	,00 +u	,00 -u		,13 -u	,32 -u	
I-CC	112	122			124	131
T-test-u	,00 -u	,55 -u			,45 -u	
I-SC	104	127	150	141	117	129+
T-test-u	,00 +u	,00 +u		,00 +u	,01 +u	

Table 3-a: F0 means in Spanish NP1, male voice.

F0 (Hz) Male	Preton NP3	Tonica NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	105	120			115	94
T-test-u	,00 +u	,16 -u			,00 +u	
D-SC	108	107	105	118	106	94

T-test-u	,25 -u		,32 -u		,00 +u	,00 +u
I-CC	92	91			92	114
T-test-u	,55 -u		,97 -u			,00 +u
I-SC	95	97	107	91	96	113
T-test-u	,14 -u		,00 +u		,06 -u	,00 +u

Table 3-b: F0 means in Spanish NP3, male voice.

F0 (Hz) Female	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	208	241			235	263
T-test and u	,00 +u		,56 -u			,00 +u
D-SC	200	230	254	236	225	245
T-test and u	,00 +u		,00 +u		,06 -u	,00 -u
I-CC	204	237			242	233

T-test and u	,00 +u		,53 -u			,26 -u
I-SC	199	223	261	269	233	215
T-test and u	,00 +u		,00 +u	,00 +u		,00 -u

Table 4-a: F0 means in Spanish NP1, female voice.

F0 (Hz) Female	Preton NP3	Tonica NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	195	218			182	157
T-test-u	,01 +u		,16 +u			,00 +u
D-SC	195	191	196	215	183	167
T-test-u	,19 -u		,68 -u	,00 +u		,00 +u
I-CC	188	183			175	200
T-test-u	,07 -u		,06 -u			,00 +u
I-SC	188	188	201	179	184	201
T-test-u	,82 -u		,00 -u	,24 -u		,00 +u

Table 4-b: F0 means in Spanish NP3, female voice.

CATALAN

Length (ms)	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	31	60			51	50
T-test-u	,00 +u	,00 -u			,83 -u	
D-SC	42	54	44	47	56	48
T-test-u	,00 -u	,00 -u		,00 -u	,00 -u	
I-CC	34	64			55	52
T-test-u	,00 +u	,02 -u			,33 -u	
I-SC	44	55	46	48	59	49
T-test-u	,00 -u	,00 -u		,00 -u	,00 -u	

Table 5: length means in Catal NP1.

Loudness (dB)	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	93	99			98	98
T-test-u	,00 +u	,13 -u			,88 -u	
D-SC	96	98	97	97	99	95
T-test-u	,01 -u	,07 -u		,01 -u	,00 -u	
I-CC	92	100			96	97
T-test-u	,00 +u	,01 -u			,57 -u	
I-SC	97	97	98	99	99	97
T-test-u	,74 -u	,21 -u		,54 -u	,01 -u	

Table 6: loudness means in Catalan NP1.

F0 (Hz) Male	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	100	110			120	129
T-test-u	,00 +u	,00 +u (1,51 st)			,02 -u	
D-SC	98	112	123	111	112	121

T-test-u	,02 +u		,00 +u	,78 -u		,00 -u
I-CC	102	119			116	124
T-test-u	,00 +u		,63 -u			,08 -u
I-SC	101	113	137	130	114	129
T-test-u	,00 +u		,00 +u	,01 +u		,00 +u

Table 7: F0 means in Catalan NP1, male voice.

F0 (Hz) Female	Preton NP1	Tonica NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	222	256			252	248
T-test-u	,00 +u		,66 -u			,67 -u
D-SC	214	255	275	242	222	244
T-test-u	,00 +u		,00 -u	,00 -u		,00 +u
I-CC	228	265			240	249
T-test-u	,00 +u		,12 +u			,42 -u
I-SC	219	260	295	267	214	247
T-test-u	,00 +u		,00 +u	,00 +u		,00 +u

Table 8: F0 means in Catalan NP1, female voice.

FRIULIAN

Length (ms)	Preton NP1	Tonic NP1	Poson NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	45	102			114	39
T-test-u	,00 +u		,00 -u			,00 +u
D-SC	49	92	45	52	95	60
T-test-u	,00 +u		,00 +u	,00 +u		,00 +u
I-CC	45	90			110	38
T-test-u	,00 +u		,00 -u			,00 +u
I-SC	47	86	45	53	91	56
T-test-u	,00 +u		,00 +u	,00 +u		,00 +u

Table 9-a: length means in Friulian NP1.

Length (ms)	Preton NP3	Tonic NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	50	106			125	45
T-test-u	,00 +u	,00 -u			,00 +u	
D-SC	54	93	71	49	125	82
T-test-u	,00 +u	,00 +u		,00 +u	,00 +u	
I-CC	49	98			115	45
T-test-u	,00 +u	,00 -u			,00 +u	
I-SC	53	88	71	47	122	84
T-test-u	,00 +u	,02 -u		,00 +u	,00 +u	

Table 9-b: length means in Friulian NP3.

Loudness (dB)	Preton NP1	Tonic NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	98	99			101	98
T-test-u	,42 -u	,00 -u			,00 -u	
D-SC	98	101	97	99	99	97

T-test-u	,00 -u		,00 -u	,47 -u		,00 -u
I-CC	99	101			101	95
T-test-u	,00 -u		,08 -u			,00 +u
I-SC	99	101	97	101	100	94
T-test-u	,00 -u		,00 -u	,00 -u		,00 +u

Table 10-a: loudness means in Friulian NP1.

Loudness (dB)	Preton NP3	Tonic NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	98	96			93	90
T-test-u	,00 -u		,00 -u			,00 +u
D-SC	98	94	91	95	91	90
T-test-u	,00 -u		,00 -u	,00 -u		,00 -u
I-CC	97	97			96	93
T-test-u	,29 -u		,08 -u			,00 -u
I-SC	98	96	94	94	94	94
T-test-u	,00 -u		,080-u	,36 -u		,48 -u

Table 10-b: loudness means in Friulian NP3.

F0 (Hz) Male	Preton NP1	Tonic NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	112	109			105	122
T-test-u	,18 -u		,20 -u			,00 +u
D-SC	109	117	116	104	108	124
T-test-u	,00 -u		,19 -u	,03 -u		,00 +u
I-CC	121	131			115	99
T-test-u	,00 -u		,00 +u			,00 +u
I-SC	119	126	116	129	114	100
T-test-u	,00 -u		,00 -u	,00 +u		,00 +u

Table 11-a: F0 means in Friulian NP1, male voice.

F0 (Hz) Male	Preton NP3	Tonic NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	110	104			91	85
T-test-u	,10 -u		,00 +u			,00 -u
D-SC	113	95	98	110	89	85
T-test-u	,00 +u	,00 -u		,00 +u		,00 -u
I-CC	105	102			99	101
T-test-u	,00 -u		,00 -u			,17 -u
I-SC	109	102	105	101	101	102
T-test-u	,00 -u		,00 -u		,81 -u	,14 -u

Table 11-b: F0 means in Friulian NP3, male voice.

F0 (Hz) Female	Preton NP1	Tonic NP1	Poston NP1	Pret Ex1	Ton Ex1	Post NP1
D-CC	188	183			180	212

T-test-u	,42 -u		,33 -u			,00 +u
D-SC	183	195	185	179	182	211
T-test-u	,00 -u		,01 -u	,17 -u		,00 +u
I-CC	212	234			192	159
T-test-u	,00 +u		,00 +u			,00 +u
I-SC	203	211	199	227	190	161
T-test-u	,00 -u		,00 -u	,00 +u		,00 +u

Table 12-a: F0 means in Friulian NP1, female voice.

F0 (Hz) Female	Preton NP3	Tonic NP3	Poston NP3	Pret Ex3	Ton Ex3	Post NP3
D-CC	183	165			152	142
T-test-u	,02 +u		,00 -u			,00 -u
D-SC	192	158	165	187	146	140
T-test-u	,00 +u		,00 -u	,00 +u		,00 -u
I-CC	163	159			154	154
T-test-u	,00 -u		,00 -u			,96 -u

I-SC	175	161	168	162	159	161
T-test-u	,00 -u		,00 -u	,03 -u		,06 -u

Table 12-b: F0 means in Friulian NP3, female voice.