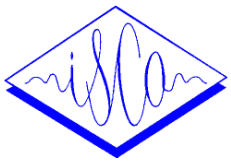
ISCA Archive
http://www.isca-speech.org/archive



Intonation:
Theory, Models, and Applications
Athens, Greece
September 18-20, 1997

AN ANALYSIS OF THE INTONATION FOR A PITCH ACCENT VARIETY OF THE BASQUE LANGUAGE

I. Gaminde(*), I. Hernáez(**), B. Etxebarria(**), P. Etxeberria(***)

University of the Basque Country
(*)Department of Psychodidactics
(**)Department of Electronics and Telecommunications
(***)Department of Basque Philology
C/Ramón y Cajal, 48014 Bilbo, Spain
FAX: +34 4 4414041: tlpgatei@lgdx02.lg.ehu.es

ABSTRACT

[1]In this paper we present the results of the analysis of the intonation for a pitch-accent variety of the Basque language. This variety is characterized by a distinctions between lexically accented words and non accented ones. This propriety have a great influence on the final intonation curve on sentences. The accent is realized as an H*L tonal melody, and conflicts between focal and lexical accents appear in the sentences construction process. Results show that different structures can be found according to the relative position of the accents. Intonation curves of declarative affirmative and questions are described.

1. INTRODUCTION

The *euskara* (basque language), despite of being one of the oldest languages in Europe and being subject in several studies, is full of linguistic unknowns, including it's place of origin. Nowadays there are 800.000 people speaking it, 600.000 of them in the Basque Country area (around the political border of France and Spain), and the other 200.000 in many other areas around the world, most of them in America.

In spite of the small number of speakers, Basque language presents a huge dialectal fragmentation. This leaded some years ago to a process of standardisation which is leaving a hole in matters related to prosody. Risk of adoption of the other co-official languages (French and Spanish) intonational patterns exists, and rises with the recent introduction of computerized speech in public services.

This language has been deeply described in certain respects such as morphology, syntax and even lexical, but its prosody remains still almost unknown, existing just a few studies about it ([1][2]and [3] among others). These studies do not offer a complete knowledge for all of the dialectal variations that can be found in the different classifications: depending on the author there are up to 8 main dialects and up to 25 minor variations for the Basque language.

Regarding the accentual systems classification, several studies have been published after the first one carried out by Michelena in 1972 (described in [1]), but none of them has been adopted as a definitive one. In [4] a division in 16 varieties is proposed, based on the following 4 criteria:

1. Distinctive value of the accent.
2. Scope of the accent insertion rules.
3. Direction followed for counting syllables and position of the head-syllable.
4. Phonetic realisation of the accent as a *pitch-accent* or *non-pitch-accent* variety.

The variety here presented, belonging to the village of Gatika, is a pitch-accent variety and its most important characteristics will be presented in the next section. Following sections will show the results of the analysis done on intonative structure of declarative affirmative simple sentences and questions.

2. ACCENTUAL SYSTEM

The most important characteristic of this variety regarding accent is the distinction made between lexically accented morphemes, that we will named as accentually *marked*, and non-accented morphemes, named *unmarked* [5][6][7]. This propriety has also been found in other varieties [8].

Both derivative and inflectional accentually marked suffixes can be further classified into two groups, depending on the way they affect the final accent position. In the first group, the suffix carries the accent over one specific syllable. In the second group, the suffix assigns the accent to the previous syllable of the word in some cases (*pre-accentual* suffixes) or to the previous but one syllable (*pre-pre-accentual* suffixes) in some other cases.

Pitch is in this variety the main correlate of accent (see also [8] for a similar variety in that respect). Accents are realized by means of an H*L tonal melody. The high tone spreads leftwards inside the word, excepting for the first syllable which shows always an L tone (unless this first syllable is an accented one in which case, the first syllable carries the high tone), whereas the L tone of the H*L accent spreads rightwards, giving way to an (L)H..H*L..L scheme.

In the process of words construction by means of convenient affixation, and if the word is pronounced in isolation, when a marked morpheme appears, it fixes the position of the accent by inserting an H*L tonal melody on the syllable carrying the

[1] This work has been supported by the University of the Basque Country (Code : UPV-147.345-EA04/96)

accent, the high tone corresponding to that accented syllable, and assigning an L tone to the next one. If there are more than one marked morpheme in the word, the accent corresponding to the first marked morpheme remains and the rest are lost. As an example, the word "bigarrenari" (to the second one) -"bi" (two), "garren" (*pre-accentual* ordinal suffix), "ari", (dative)-, results in "bi'garrenari" (where we have indicated the accent with a ' positioned after the accentuated syllable). The pre-accentual suffix "garren" inserts an H*L melody on "bi", and the result is H*LLLL. Figure 1 shows an example of the utterance "Bigarrenari pasa dako" (that what happened to the second one), where this phenomenon can be clearly observed (sentence composition will be later clarify).

Figure 2 shows an example of the utterance "Alargunenari pasa dako" where this spreading can be observed, together with the sharp drop of F0 following the last syllable of the word "Alargunenari" (to the one of the widow) -stem "alargun" (widow), "en" (genitive singular), "a" (article), "ri" (singular dative)-. In this word, every morpheme is unmarked, so the word begins with the L tone and remains high until the end of the word, or until an H*L accent is found (in this example, a focal accent). So for totally unmarked words the LH...H scheme may be adopted.

In the variety here presented, every sentence must carry a focalized element. In the Basque language, different strategies may be used to give prominence to some specific information, that is, to focalized an element. One of them is the constituents order : in general, focus is placed in preverbal position. If the focus is the verb itself, then it will appear first in the sentence. Besides this, some lexical categories have the propriety of focalizing by themselves the element they represent. The use of these focus markers is facultative. Regarding intonation it is possible to focalize a sentence constituent by means of the insertion of an H*L tone on the focalized element. These three strategies may be used separately, and any combination of all of them is also valid, but as we will see later on, a focalized element will always show an the H*L tone.

3. DECLARATIVE SENTENCES

Due to the strong influence of the marked or unmar0ked nature of the words over the general appearance of the F0 curve, we will present our analysis separately for sentences without marked words in one hand, and in the other hand sentences in which any marked word appears. Constructed sentences for the analysis in both cases include from just one element or word up to 4. Two and three syllable words may appear. Longer words and syllable were also inspected, but they were not used in the numerical analysis showed.

3.1. Declarative sentences without marked words

When there are not marked elements in the sentence, the F0 curve shows an H*L accent on the last syllable of the focalized element, that is, an F0 maximum on that syllable followed by a sharp drop as in Figure 1. After that drop, the value of F0 continues to fall slowly up to the end of the sentence. This is so no matter how many phrases can be found before or after the focalized element.

Two corpus of 48 sentences each containing 2 syllable phrases the first one and 3 syllable phrases the second one were constructed and registered for one female speaker. The phrases

N							
6	F						
	1.142	0.824	0.863				
	0.042	0.029	0.021				
12	F						
	1.226	0.760	0.905	0.980	0.983		
	0.045	0.037	0.052	0.048	0.038		
12	F						
	1.251	0.748	0.925	0.983	1.022	0.989	0.967
	0.042	0.026	0.043	0.050	0.047	0.047	0.021
6		F	F				
	1.213	0.993	1.052	0.748	0.877		
	0.039	0.022	0.039	0.035	0.014		
6		F	F				
	1.232	0.948	1.108	0.756	0.890	0.974	0.954
	0.038	0.056	0.065	0.028	0.022	0.030	0.012
6				F	F		
	1.175	1.004	1.034	0.924	1.107	0.722	0.868
	0.035	0.052	0.036	0.024	0.072	0.051	0.009
n	2	3	4	5	6	7	8

Table I.- *D(n)* mean values and standard deviation for sentences with 2, 3 and 4 two-syllable words. An F indicates that the syllable *n* belongs to a focalized word inside the sentence. N stands for the number of sentence used in the averaging, and *n* is the position of the syllable inside the sentence.

were simple words obtained by suffixation in different syntactical cases. Verbal phrase is considered a single prosodic word [4].

The value of F0 was automatically calculated from cepstrum coeficients (measuring in the point of maximum energy inside each vowel) and after human supervision of the results, the differences *D(n)* of the F0 value between one syllable and the previous one was calculated as:

$$D(n) = F0(n) / F0(n-1)$$

Table I shows mean values of *D(n)* obtained after averaging over sentences with the same number of phrases in which the focus was in the same position, for the two syllable phrases corpus (the value for the first syllable is obviously not calculated). The results show that a sharp drop (low *D(n)*) appears always next to the last syllable of the focalized word. Besides this, the maximum value of F0 in the sentence was always located on the last syllable of the focal phrase.

As can be seen in the table, after the focalized element, the F0 value falls invariable downwards up to the end of the sentence. In general, the farther the phrase is from the focus (leftwards), the closer to one is the slope. Also, when the phrase is very far from the focus may sometimes show a slight positive slope.

A very flat configuration is found before the focalized element. Same as with the postfocalized phrases, the farther the phrase is from the focus, the flatter the intonation curve, leaving apart the first syllable.

Very similar results were obtained for the three syllable phrases corpus. The same structure with a clear division of the utterances into two parts, and flat intonation curves in both parts. Figure 3 shows the utterance "gizonak piperra saldu dau"

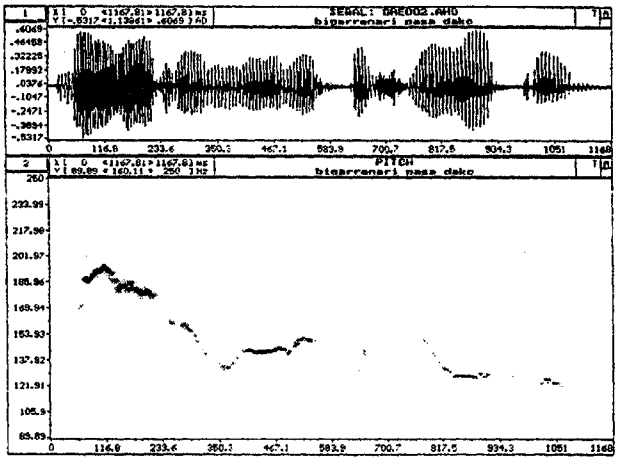


Figure 1..F0 curve for the utterance "bi'garrenari pasa dako" (*It has happened to the second one*). Lexical accent is on the preverbal constituent.

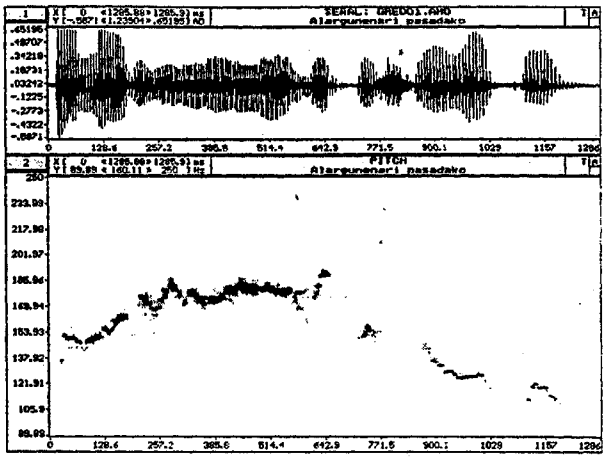


Figure 2. F0 curve for the utterance "alargunenari pasa dako" (*it happened to the one of the widow*). Both phrases are lexically unmarked.

(the man has sold the pepper) where the above mentioned characteristics are clearly observed.

We can conclude that declarative sentences with no marked elements, can be seen as constructed by two main constituents : a first one including all words or phrases up to the focalized element and including it, and a second one from it up to the end. So, an H*L accent can be placed on the last syllable of the focalized element and leftwards spreading of the H tone up to the second syllable of the sentence occurs, as well as rightwards spreading of the L tone up to the end of the sentence, i.e., the corresponding scheme could be:

LH.....H*L.....L

We will call this structure the *basic* sentence structure.

3.2. Declarative sentences with marked words

3.2.1. Post-focus marked elements

When marked constituents appear in the sentence, the relative position of those marked constituents relative to the focus element must be taken into account.

If a marked word is located after the focus element and all prefocal phrases are unmarked. the intonative structure keeps the above described rules for the first part of the utterance, and the same amount of F0 drop appears in the same place as before, even if the syllable receiving the L tone is the accentuated one. However. while in the unmarked postfocal phrases case the slope drops dramatically from the focus and continues downwards up to the end, in this case the lexical accents insert F0 drops on the syllable next to the accentuated ones, and the F0 value is maintained when going towards an accentuated syllable.

So we may say that post-focal lexical accents slightly modify the intonation of the basic structure, by introducing drops on the syllable that follows the accentuated one.

3.2.2. Marked elements focalized

If the marked element appear in the first part of the sentence, two cases must be considered : the focus element is the only lexically marked element on the one hand, and the rest of the cases on the other hand.

If just one marked element appears in the first part of the sentence, and it is located in focal position. the intonative basic structure just described remains, the only difference being in the position of the lexical H*L accent, which will be located on the syllable which carries the lexical accent. Also, the drop of F0 is not as sharp as before particularly when the lexical accent lies on the first syllable, although final value reached by F0 remains approximately the same. Figure 1 shows an example of such a case and should be compare with Figure 2.

3.2.3. Marked elements in pre-focal position

When marked elements are located in pre-focal position, the basic structure that differentiates pre- and post-focal constituents disappears. In general, it may be said that pre-focal lexical accents dominate the intonative curve. The H*L focal accents continues to exits, but, as heavy F0 drops have already been introduced pre-focally, much less variation margin is left to the focal accent. Our speaker in particular showed a quiet stable dynamic range of F0, so in sentences with more than 2 pre-focal marked words, focal accent shows clearly weaker than lexical ones. However, although much difficult to observe in the F0 curve, focal accent is still appreciated when relative measures of F0 variations are taken (i.e. *D(n)*).

A remarkable phenomenon that occurs in marked pre-focal elements is that the lexical H*L melody doesn't appears on the accentuated syllable of the phrase but in the last one, even that lexical accent may never appear in that position. This was observed only in pre-focal position and in sentences with two preverbal constituents the first being marked and the second one -focus- unmarked). It can be observed in Fig. 4, in which the first word "gusu'rtik" is lexically accented on the second syllable. When lexical accent lies on the first syllable, the F0 initial value is higher, and continues rising up to the last syllable. In sentences with more than two preverbal elements the H*L tone did not always moved to the last syllable. However, the use of sentences with more than two preverbal constituents is not very common without a pause in between, so it may be the reason for this irregularity.

If in a two preverbal constituents sentence the second one - focus- is also marked, the final configuration depends strongly

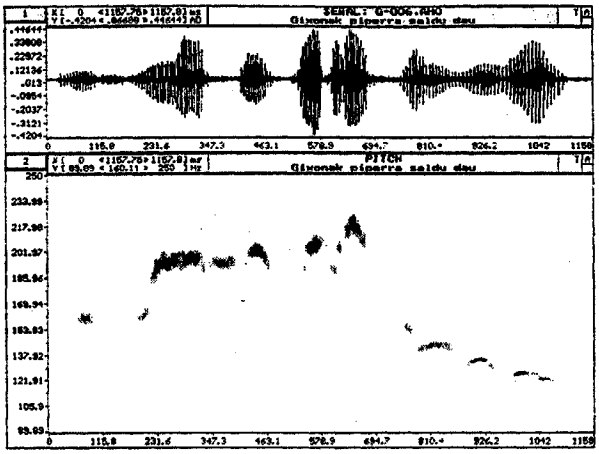


Figure 3 F0 curve for the utterance "Gizonak piperra saldu dau" (*The man has sold the pepper*). All the constituents are unmarked.

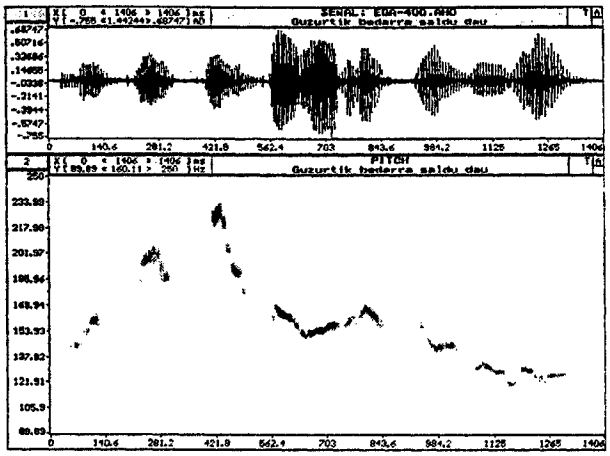


Figure 4 F0 curve for the utterance "Gusurtik bedarra saldu dau" (*The lier has sold the grass*). Both phrases are lexically unmarked.

on the position of the accent in both words and on the number of syllables of each one. The effect of the second marked element is to modified the speed of the F0 drop, same as did post-focal marked elements, but with greater influence this time.

4. QUESTIONS

4.1. Yes/no questions

Yes/no questions corpus used in the analysis consisted on the same structures used for the analysis of declarative sentences put in question form. Questions showed an intonation curve very similar to their corresponding declarative, with some variations which differentiate them. Differences begin from the focalized element up to the end on the sentence. So following the same rules as with declarative, we find a pitch drop from the focalized element on, the drop being less as pronounced. Then pitch value is maintained (or it falls with a slight negative slope if there are many post-focal elements) to rise again fast at the last syllable, reaching a value higher than the maximum of the first part of the sentence.

4.2. Question-word questions

In question-word questions, the question-word is the focus of the sentence and appears always at the begining of the sentence. The intonative curve follows the rules of declarative sentences with the focus in first position, that is, a very high pitch value for the accentuated syllable of the question-word, followed by a sharp drop in next syllable, and from them a smooth negative slope up to the end.

5. CONCLUSIONS

We have presented here the results of the analysis of the intonation of a limited set of sentences. The carried analysis includes other kind of sentences such as negatives, emphatic questions, leading questions and others. Complex phrases were also analyzed, as well as the effect of using lexical markers in focusing, but we have limited our presentation to the most basic structures. Some numerical models for basic strucutres have already been defined, and are on the process of being evaluated. However, the variety here presented while being a good representative of its kind, is not a majority one, and similar analysis is being also carried on other varieties.

REFERENCES

[1] L. Michelena, *"Fonética Histórica Vasca" 2nd ed.*, (in Spanish) Diputación de Guipúzcoa, San Sebastián 1977.

[2] J. I. Hualde, *"A lexical phonology of Basque"*, Ph.D. Dissertation, Faculty of Graduate School. University of Southern California, 1988.

[3] Txillardegi, "*Euskal Azentuaz*", (in basque) Elkar, Donostia, 1985.

[4] I. Gaminde *The accent of the basque people* unpublished , 1997

[5] I. Gaminde *"Urduliz eta Gatikako herri hizkeren azterketa linguistikoa"* (in basque) Ph. D. Dissertation, University of Deusto, Bilbo, 1992

[6] I. Gaminde "Bizkaiko azento-motei buruz" (in basque) Uztaro, N° 7, Udal Herriko Unibertsitatea, Bilbo, pp. 111-140, 1993

[7] I. Gaminde *"Mendebaldeko azentuak"*, Mendebaldeko euskara XX. Mende goienean, Mendebalde euskal kultur Elkartea, pp. 177-190, 1997

[8] J.I. Hualde, G. Elordieta, A. Elordieta, "The basque dialect of Lekeitio", Supplements of 'Anuario del Seminario de Filología Vasca Julio de Urquijo' XXXIV, Bilbao, 1994