

INTONATION MODELLING FOR THE SOUTHERN DIALECTS OF THE BASQUE LANGUAGE

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ABSTRACT

In this paper we present part of the analysis performed on intonation for the Basque language¹. After a brief description of the most relevant characteristics of the language, criteria for corpus fulfilment and speakers selection is described. Results of the analysis show the importance of the *F0* drop in focus positioning. A first classification of the selected varieties is done according to the accent position and *F0* values relationships.

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 its 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. In modern times, written basque is being standardised, but there is not a standard version for spoken basque. 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 accent 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.

In our research we have considered mainly the fourth criterion, because of its influence on the intonative structure. The pitch-accent realisation consists in the spreading of the High tone linked to the accented syllable towards the beginning of the phrase, excluding the first syllable.

Another important aspect in basque is the position of the focus element and its relationship to syntax and intonation [4]. The clause's elements in basque may be focalized following three different strategies:

1. By the use of different phonological or lexical markers.
2. Following the order of the components of the clause.
3. According to pragmatic criteria.

Each of these strategies can fix completely the focus element, but usually a combination of the three of them is used.

The ultimate goal of this work was to find a set of rules for developing intonation curves automatically from written text to be applied in a text-to-speech system for basque [5]. In order to do so, we first have tried to find intonation schemes. Also of interest was studying the possible links between accent-systems and "intonative" systems. Finally, phonological accent position is known to show a *F0* maximum when isolated, but this high tone may vary when phrases are concatenated together to construct sentences [4]. We analyse this aspect in Section 5.

2. DATA BASE DESCRIPTION

2.1 The sentences

We designed a corpus composed by 40 declarative clauses. We selected words with 2 and 3 syllables and

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belonging to the *unmarked* category, for all the villages where we were going to carry on our analysis, and the clauses were composed by 2 and 3 phrases.

We didn't consider any distinction between *marked* and *unmarked* units, that should be performed according to the first criterion on those basque varieties where the accent shows a distinctive value, and we restricted the work to *not-marked* units which follow the standard rules of accentuation inside every variety.

All of the allowed syntactical variations were included (Table 2.1a). Moreover, each of the previous syntactical variation can be located in different positions relative to the focus (Table 2.1b)

syntactical variation	K
subject (<i>ergative</i>)	1
verb	2
object	3

Focus position	F
pre-focal	-1
focal	0
post-focal	1
after post-focal	2

Table 2.2 shows the number of instances as first, second or third phrase ($S=1,2,3$) for each different syntactical variation K (Table 2.2a) and relative position F (Table 2.2b).

		S		
		1	2	3
K	1	12	12	8
	2	12	12	8
	3	16	16	8

		S		
		1	2	3
P	-1	8	0	0
	0	32	8	0
	1	0	32	8
	2	0	0	16

Table 2.3 shows the values for F and K for the ten basic sentence structures.

F	K	F	K
0 1	1 3	0 1	2 3
-1 0 1	1 2 3	-1 0 1	2 1 3
0 1 2	1 3 2	0 1 2	2 3 1
0 1	3 1	0 1	3 2
0 1 2	3 1 2	0 1 2	3 2 1

Based on these ten basic structures, the corpus was composed by 10 clauses using just 2 syllable phrases, another 10 using just 3 syllable phrases, and 20 more using a mixture of both 2 and 3 syllable phrases.

2.1 The villages

We selected 25 villages located all around the basque geography, representing two of the main dialectal variations in the southern area.

According to the classification in [4] the chosen varieties belong to 6 different groups :

Group 1: ABA, LAR, HER, TOL, OIA, ORI, ZAL, ZUM

Group 2: ARE, OTX, ZOL

Group 3: ANT, AZK, BER, EIB, GET

Group 4: FRU, MUX, ELA, GAT, LEK

Group 5: MAR, OND, MUN

Group 6: DIM

Groups 4 and 5 are both of the pitch-accent type.

In each village, just one representative speaker was selected, most of them being females. Position of the phonological accent in all groups except for Group 4 is the last syllable but one, and last syllable for Group 4.

2.3 F0 Analysis

No indication on focus element was given to the speaker in the moment of making the recordings. The text was written in the local dialect, so the utterance were to be pronounced in a natural fashion. This aspect introduced some complication in the analysis as some syllables were elided. Also, in some recordings, reading effect was remarkable.

The sentences were digitised using a 16kHz sampling rate. The fundamental frequency was obtained for each of the syllables in the clause. This value was computed at the instant of maximum power within the vowel; whenever this instant was not well defined, the pitch value at an instant approximately in the middle of the vowel was used instead. The $F0$ values were computed from the cepstral spectrum. The whole process was automatic, with human supervision of the results.

Besides the absolute values for $F0$, we also obtained a derivative computed as:

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

where n is the syllable index, and $D(0)=1$. This way we normalised the pitch contours to make possible the comparison among all of them.

3. FOCUS POSITION

In previous studies for specific dialects [7] maximum value of $F0$ was established to show on the focalized phrased. Also, a sharp drop of the $F0$ value [8] appears according to [5] in another variety, both varieties being of the *pitch-accent* type. We have studied this aspect with a double objective in mind: to check the focus assignment as indicated by the syntactic structure (as the speaker didn't have any other information about it), and on the other hand, to validate maximum $F0$ or ' $F0$ -drop' use for focus positioning.

The carried analysis showed that the maximum value of $F0$ was located on the syntactically focalized phrase in 85% of the cases. But it was so, mainly when the focus was in first position ($F=0, S=1$) (94% of the times the focus appeared in that position), but in only 54% of the $F=0, S=2$ existing cases. Another worrying aspect was that maximum had also been found in $S=1, F=-1$ position 125 times of the possible 194 (63%). Moreover, some $F0$ maximum occurred also in $F=1, S=2$. Maximum $F0$ occurring in $S=3$ (24) position were due to an exaggerated intonation of confirming an affirmation ("[Yes, of course!] The dog has eaten the bone!") given

to the sentence by some speakers to some of the sentences.

The same data were extracted for maximum value of $F0$ drop (minimum $D(n)$). $F0$ -drop is located in some syllable on a $F=0$ (21%) or $F=1$ (66%) position in the 87% of the cases, and some 33% on $F=2$ position. As this is strongly related to accent-due local maximum moving phenomenon, we will comment this aspect later in this paper (Section 5).

Following with the $F0$ -maximum analysis, we divided the data into sentences with 2 and 3 phrases ($NS=2, 3$). This would obviously simplify matters for the $NS=2$ sentences, as focus may then appear only in $S=1$ position. As expected, a maximum was located in every $F=0$ position. It also appeared sometimes (38 out of 400) on $F=1$ position, due to the above mentioned special intonation. Worth to mention is the fact that the maximum appeared *repeated* inside the phrase in some 39 cases. No relation with syntactical case, number of syllables or other studied parameter was found to correlate with this phenomenon.

The same analysis performed over the 600 $NS=3$ sentences gave us an interesting fact: 40 of the 60 cases were maximum was on $F=1$ position ($S=2$, i.e. not a final phrase) were given for verbal phrases ($K=3$). That is to say, even that syntax rules indicate that the verbal phrase must be the first phrase to be the sentence focus, speakers feel free to focalized it in some other position too. However, 10 speakers didn't show any maximum in tag position: ANT, FRU, GAT, GET, LEK, MAR, MUN, OND, OTX. Note that 6 out of the 8 *pitch-accent* varieties are included in that group.

4. ACCENT POSITION

In this section we'll try to find is some relation between the $F0$ -maximum position on an specific syllable and the fact that the syllable is or is not phonologically accented.

The accent matches a $F0$ -maximum whenever the phrase is isolated. We wanted to know if that maximum persisted when the phrase is in focus position. We will also make some considerations above $F0$ -drop. This time we will consider only those clauses where the speaker places the pitch maximum in phrases verifying $F=0$.

Table 4.1 shows the results we got for clauses with 2 and 3 phrases. Results are shown separately, subject and object syntactical cases ($F=0, K=1,2$) in **Table 4.1a**, and **Table 4.1b** for the verbal phrase ($F=0, K=3$). Accented cases are under A=1 column, and A=0 stands for non accented ones..

Depending on whether the maximum position is or is not over the accented syllable and considering **Table 4.1a**, we have classified the villages in two groups (shown in **Table 4.2** where it is also pointed the classification of the villages according to the Groups presented in Section 2). It should be underlined here that both varieties 4 and 5

Table 4.1a					Table 4.1b				
F=0	S=2		S=3		F=0	S=2		S=3	
K=1, 2	A:0	A:1	A:0	A:1	K=3	A:0	A:1	A:0	A:1
ABA	5	3	6	1	ABA	5	4	1	3
ANT	0	8	3	5	ANT	1	10	0	5
ARE	7	2	5	3	ARE	6	3	4	0
AZK	7	1	7	1	AZK	1	8	1	3
BER	7	1	6	0	BER	9	2	4	0
DIM	6	1	11	2	DIM	1	9	0	5
EIB	4	3	5	10	EIB	2	7	1	4
ELA	2	8	4	6	ELA	2	9	2	5
FRU	2	6	3	13	FRU	2	9	2	5
GAT	0	8	3	13	GAT	4	6	1	4
GET	8	0	13	0	GET	8	2	5	0
HER	4	5	9	7	HER	6	6	0	3
LAR	1	5	3	7	LAR	7	1	2	0
LEK	0	8	0	7	LEK	6	6	2	3
MAR	4	5	2	8	MAR	2	9	0	2
MUN	4	8	3	13	MUN	1	10	0	5
MUX	0	8	3	7	MUX	1	6	0	3
OIA	0	6	1	5	OIA	1	8	0	0
OND	0	8	0	12	OND	2	9	0	5
ORI	0	8	0	8	ORI	1	9	0	5
OTX	5	3	5	5	OTX	2	8	1	5
TOL	8	0	9	0	TOL	7	2	2	0
ZAL	4	3	1	5	ZAL	2	4	1	4
ZOL	8	1	7	0	ZOL	9	1	1	0
ZUM	8	0	7	2	ZUM	7	3	5	1

are of the *pitch-accent* type, and they are both located in the same column.

We observe some differences between **Table 4.1a** and **b**:

- Villages AZK and DIM have changed group, i.e. they show an opposite relation of the accent and the $F0$ -maximum.
- Group B shows the same proprieties for all speakers excepting LEK.
- MAR, which is also a *pitch-accent* variety shows now as a more confident member of group B.

Table 4.2a	
Group A	
AZK(*)	3
BER	3
GET	3
ZUM	3
TOL	1
ZOL	2
DIM(*)	6

Table 4.2b	
Group B	
FRU	4
GAT	4
LEK	4
MUX	4
MUN	5
OND	5
ORI	1
OIA	1

We can conclude that in general, *pitch-accent* varieties show a more stable relationship with syntactic case (LEK excluded) between $F0$ maximum and phonological accent.

5. $F0$ DROP ANALYSIS

Table 5.1a shows the distribution of the minimum value of the $F0$ derivative among the different villages and discriminating by focus position. First to note is that some values appear in $F=2$, which means that final

phrases may suffer a drop in F_0 value. Note however that this doesn't happen at all for DIM, FRU, GAT, MAR, MUN, OND, and OTX. Last 6 coincide with the ones that didn't freely focalized the phrasal verb by putting an F_0 maximum on it, and 5 of them are again pitch-accent varieties.

If final phrases are eliminated from the analysis, a more clear picture of the situation may be found for some of the villages. Results are shown on **Table 5.1b**. Shown values of F_0 -drop are related now solely to focus influence. In this case just 16 cases remain valid for $F=1$ position, and all 40 for $F=0$. So, taking into account our previous classification of F_0 -maximum moving or not with respect to the phrase isolate condition (**Table 4.2**), we can now check the hypothesis that a focalized syllable is characterised by a following F_0 -drop. Varieties from group A should show F_0 -drop on $F=1$ position (because maximum has moved to the last syllable of the $F=0$ phrase), as well as those from group B belonging to Group 4 accent systems. This happens to be true for FRU, GAT, GET, LEK, MUX, OIA, OND, and ORI. Nothing can be said about TOL, ZOL. MUN doesn't seem to follow his companions in this table.

Nevertheless, some villages didn't show a minimum in final $F=2$ phrases, so we shouldn't consider a final phrase effect on $F=1$ final phrases. Then MUN comes in again, and so do BER, TOL, ZOL, ZUM, but OND should be reconsidered.

A final point could be made on the syllable position inside the phrase of the F_0 -drop. When a maximum F_0 -

drop lied on $F=2$ phrases, it was mostly found to be on the first syllable in spite of the accent position being some other syllable (position of F_0 -maximum and drop analysis regarding syllable position not shown here in this work). If final phrase effect was to be considered, it must be done in the sense that final phrase can never be the focus, so, if a F_0 -drop has not been realised in previous phrases, it must necessarily go to the last one.

6. CONCLUSIONS

Basque language presents an unquestionable state of fragmentation. Accent has been analysed recently, and 16 different set of rules have been found to describe it. So we could not pretend to state a whole description of the intonation facts just by selecting some sentences and villages. However, some facts have been reinforced after this work: *pitch-accent* varieties (most of them) remain soundly established as a group with a regular behaviour regarding intonation. Some others, in spite of belonging to the same accent-system set of rules, did not the same for intonation (ZUM, TOL vs. OIA, ORI). Also, specially some cases (MAR, ELA, LEK,...) should be repeated in order to eliminate speaker dependence of the results.

We think that maximum F_0 -drop is a good marker of focus position, occurring over the syllable following the local F_0 maximum linked to the phonological accent of the phrase. However, some controlled tests on focus position perception should be performed to validate maximum F_0 -drop as a post-focus marker in every variety.

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7. REFERENCES

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Table 5.1a

	F			
	-1	0	1	2
ABA		10	22	6
ANT		15	21	2
ARE		6	23	9
AZK		9	26	3
BER		7	19	12
DIM		10	27	0
EIB		11	25	1
ELA		1	30	6
FRU		1	37	0
GAT		2	36	0
GET		2	34	2
HER		10	25	1
LAR	1	3	24	10
LEK		5	27	6
MAR		10	28	0
MUN		6	32	0
MUX		4	29	4
OIA	3	14	17	4
OND		16	22	0
ORI		30	5	2
OTX		10	28	0
TOL		3	22	13
ZAL		8	23	7
ZOL		4	21	13
ZUM		1	21	14

Table 5.1b

	F		
	-1	0	1
ABA		10	6
ANT		15	5
ARE		6	4
AZK		9	9
BER		7	2
DIM		10	9
EIB		11	9
ELA		1	6
FRU		1	12
GAT		2	12
GET		2	11
HER		10	7
LAR	1	3	4
LEK		5	8
MAR		10	9
MUN		6	11
MUX		4	8
OIA	3	14	5
OND		16	4
ORI		30	0
OTX		10	12
TOL		3	1
ZAL		8	4
ZOL		4	0
ZUM		1	0