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SPONTANEOUS SPEECH INTONATION IN (EUROPEAN) PORTUGUESE: AN EXAMPLE OF EXPERIMENTAL ANALYSIS WITH A MACROSYNTACTIC VIEW

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ABSTRACT: Besides studies based on illocution criteria (Raso & Mello, 2009), most research conducted on Portuguese intonation pertains mainly to read speech, and uses for a large part either the autosegmental--metrical framework – AM - (Frota & al., 2007) or, for a small number, a phonosyntactic model (Martin, 1999, 2004). In papers pertaining to the last category, there is a clear assumption that the sentence prosodic structure is independent but associated to syntax. In this view, prosodic contours located on or around stressed syllables function as phonological markers of the prosodic structure. Experimental studies on simple sentences read in Portuguese describe for example a high and rising melodic contour located on the first stressed syllable of a subject NP, and either a rising contour (on the stressed syllable) or a complex contour (falling on the stressed syllable and rising on the last syllable) of the last unit of a SN syntagm.

Whereas this description is essentially compatible with those given in the AM framework, the validity of AM theory may be questionable if extended to non-prepared (spontaneous) speech. In such cases, a macrosyntactic approach proves to be an effective tool, as it envisions the sentence as a sequence of macrosegments (pre-nucleus, nucleus, post-nucleus and parenthesis), syntactically well formed in the classical sense, but whose relations of parataxis or dependency with each other are indirectly determined by the sentence prosodic structure. This paper presents a short example of analysis, showing the interaction between macrosyntactic and prosodic structures, the latter (re)structuring the sequence of macrosegments organized (by definition) in a flat structure in the sentence.

KEY WORDS: Portuguese, intonation, macrosyntax, spontaneous speech

RESUMO: Com exceção dos estudos que se baseiam em critérios ilocucionais (Raso & Mello, 2009), a maior parte das pesquisas sobre entoação do português baseia-se na fala lida e usa, em grande medida, seja a abordagem autossegmental-métrica - AM (Frota & al., 2007), seja, em menor número, um modelo fonossintático (Martin, 1999, 2004). Nos trabalhos do segundo tipo, há um claro pressuposto de que a prosódia da frase, embora associada à sintaxe, é independente. Nessa perspectiva, os contornos prosódicos localizados nas sílabas acentuadas, ou próximo a elas, funcionam como índices fonológicos da estrutura prosódica. Estudos experimentais realizados com frases lidas em português descrevem, por exemplo, um contorno melódico alto ascendente na primeira sílaba acentuada de um SN sujeito, seguido de um contorno ascendente (na sílaba acentuada) ou de um contorno complexo (descendente na sílaba acentuada e ascendente na última sílaba) na última unidade do SN.

Ainda que essa descrição seja essencialmente compatível com a teoria AM, a validade dessa abordagem pode ser questionável se aplicada a dados de fala não planejada (espontânea). Nesses casos, uma abordagem macrossintática revela-se uma ferramenta eficiente, uma vez que ela concebe o enunciado como uma sequência de macrossegmentos (pré-nucleo, núcleo, pós-núcleo e parênteses) sintaticamente bem formada, no sentido clássico do termo, mas cujas relações de parataxe ou dependência entre os macrossegmentos são indiretamente determinados pela estrutura prosódica da frase. Este artigo apresenta um breve exemplo de análise, mostrando a interação entre estruturas macrossintáticas e estruturas prosódicas, as últimas (re)estruturando a sequência de macrossegmentos organizados (por definição) em uma estrutura linear na frase.

PALAVRAS-CHAVE: Português, entoação, macrossintaxe, fala espontânea.

1. Introduction

Analysis of spontaneous (i.e. non prepared) speech generally reveals the presence of typical characteristics such as hesitations words, abandons followed by reformulations, repetitions, ponctuants (*ne,…*), but the most interesting difference pertains to the regular absence of a unique complete syntactically well-formed sentences. To analyze the structure of spontaneous speech production, macrosyntax analysis applied to French emerged in the last 10 or 15 years (Blanche-Benveniste, 2000). Macro syntax proceeds by segmenting the text in various macrosegments, which can be defined roughly as delimited to the left and to the right (i.e. before and after on the time axis) by an absence of dependency being considered strictly from a syntactic point of view (thus excluding semantic dependencies). This means that each macrosegment results from the maximum grammatical expansion in

the classical well-formed syntactic sense. One of these macrosegments, called the nucleus, is special as it can form by itself a complete well-formed sentence both on the syntactic and prosodic levels. It can thus be extracted from the sentence (with a sound editor for example) and syntactically (for the text) and perceptively (for the intonation) appear as well formed and complete. The nucleus stands therefore by itself as a sentence with illocutionary value. Other tests, for example implying a change in modality (positive into negative, declarative into interrogative) can also be conducted in order to assert the character of nucleus of a given macrosegment. Macrosegments that precedes the nucleus are called prenuclei, and those that follow postnuclei. Since no dependency relations between macrosegments do exist by definition, prenuclei, nucleus and postnuclei form a flat structure in the sentence.

Independently from the macrosyntactic analysis performed on the "text" of the sentence, (text as it could appear in a written transcription devoted from any punctuation), sentence intonation, as indicated by melodic contours located on stressed syllables, can also be analyzed into prosodic macrosegments, not necessarily congruent with the text flat macrostructure. Instead of being analyzed into Prenucleus, Nucleus and Postnucleus, as macrosegments pertaining to the text, sentence intonation can be analyzed into a prosodic nucleus and one or more postfixes. There is no prosodic macrosegment that would precede the prosodic nucleus and that would be prosodically independent from it (Martin, 2009). The prosodic nucleus is generally composed of prosodic "syntagms", i.e. groups of stress groups (units containing only one stress), which maintain a dependency relationship with the final melodic contour located on the last stress group of the nucleus. A prosodic nucleus can eventually be followed by a postfix, with reduced melodic variations, corresponding to the old terminology *theme* in a theme-propos division of the sentence, or to the prosodic sequence following a wide focus mark in the sentence.

Intonation system in Portuguese

Analysis of sentence intonation is independent from the text and its macrosyntactic structure and aims to identify the sentence prosodic macrosegments as nuclei and postfixes, as well as their prosodic components. Simple read sentences, as on the left side of Fig. 1, reveal rising realizations of the first stressed syllable melodic contour. However, in certain less frequent cases, a fall is also observed in similar cases (right side of Fig. 1).

Prosodic nuclei end with an easily recognizable falling contour (usually called terminal conclusive), generally reaching the lowest fundamental frequency value of the whole sentence, whereas prosodic postfixes bear rather flat intonation contours on the text stressed syllables. Large components of the nuclei are associated on the last stressed syllable with typical *continuation majeures*, instantiated

in Portuguese by either a rising contour on the last stressed syllable of the corresponding text (Fig. 3), or a flat or slightly falling contour on the stressed syllable and a rising contour on the final syllable (Fig. 7). The example *a autoridade do governador diminui* is especially simple as all stressed vowels are in final position for each stress group *a autoridade*, *do governador* and *diminui*.

The identification of these prosodic markers is done by listening to the recording and was analysis with the speech analysis software WinPitch. The resulting fundamental frequency curves are segmented so that the melodic contours located on stressed syllables appear circled in the graphs.

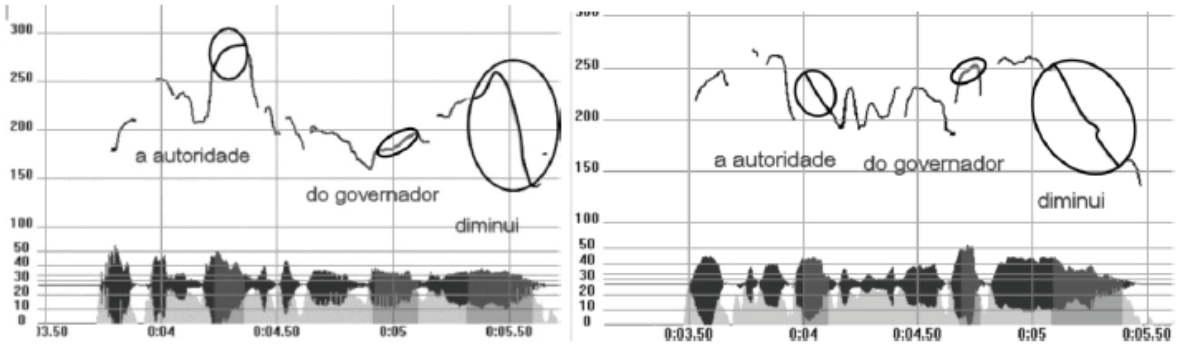

Fig. 1. Two different realizations of the read sentence *a autoridadade do governador diminui* **(segments of melodic curves corresponding to a stressed vowel are circled)**

The variation of F0, fundamental frequency of the voice correlated with the melodic perceived height variations, are represented on a linear frequency scale in function of time. Gaps in the curve correspond to either silence or unvoiced speech segments. F0 segments aligned on stressed vowels are circled and highlighted.

2. Analysis

2.1. An example

The short example analyzed below is extracted from the C-ORAL-ROM corpus (Cresti & Moneglia, 2005), file PFAMCV03, and consists of one female European Portuguese speaker GRA. Graça is a woman, psychologist, recorded in her home in Lisbon. She is talking to two researchers about ways of addressing to people and her flying experiences. The recording belongs to a collection of spontaneous conversations recorded in family environments. Transcribed without any punctuation, the text appears as follows:

**GRA: terrível não é eu aliás conheço um médico que é o Costa Quintao António Costa Quinta conhecido pelo Tó o Tó Costa Quinta que é a mesma coisa que bebe como uma esponja é dos tais que não não se altera porque é realmente bem educado mas que chega a qualquer sítio e ao fim de cinco minutos está a falar sobre guerra a guerra de África e até acabar até se ir embora fala sobre a guerra de África eu acho eu só tenho um termo em francês para definir um tipo destes é um emmerdeur.*

(Terrible no. By the way I know a doctor, Costa Quinta, António Costa Quinta, known as Tó or Tó Costa Quinta, which is the same thing, who drinks as a sponge and is such that he does not get excited because he is really well-behaved, but when he arrives anywhere, after five minutes, he begins to speak about the war, the war in Africa and until he finishes, until he leaves, he speaks about the war of Africa. I only think I have a term in French to define a type of this kind: it is an *emmerdeur*).

2.2. General characteristics

Spontaneous speech production is often characterized by the presence of hesitations, repetitions, reformulations and ponctuants normally not found in read speech (i.e. read from written text). In this short sample, we find one reformulation (*guerra a guerra de África*), no hesitations, one repetition (*não não*), a long nucleus and no ponctuants.

2.3. Text analysis in macrosegments

However, the main characteristics of non-prepared speech pertain to the macrosyntactic organization of the text in prenuclei, nucleus, parenthesis and postnuclei. The text is thus segmented in macrosegments by identifying lack of dependency relations between syntagms. Then, from the syntactic properties of analyzed macrosegments, we can extract the potential nuclei and test their characteristics (illocutionary property, change in modality, etc.). Reduced to its macrosyntactic text nuclei, the text becomes:

1. terrível não é
2. eu aliás conheço um médico que é o Costa Quinta que bebe como uma esponja é dos tais que não se altera porque é realmente bem educado mas que chega a qualquer sítio e ao fim de cinco minutos está a falar sobre a guerra de África e até acabar até se ir embora fala sobre a guerra de África
3. *é um emmerdeur*

The only prenucleus is *eu acho eu só tenho um termo em francês para definir um tipo destes*. Compared to other examples of this recording, one nucleus is relatively large, and interrupted by the parenthesis *# o António Costa Quinta conhecido pelo Tó # o Tó Costa Quinta # que é a mesma coisa #* We will now examine how intonation revealing the sentence prosodic structure is restructuring the text, possibly merging two adjacent text macrosegments or splitting a text prenucleus or nucleus into distinct macrosegments.

2.4. Intonation analysis

2.4.1. Prosodic nucleus

As expected by definition, prosodic nuclei are ended by a conclusive melodic contour realized by a generally rising melodic contour on the last stressed syllable followed by a falling contour on the last syllable of the prosodic nucleus (see Fig. 9 below). When the last stressed syllable is also in final position, it will bear a complex rise-fall contour as in Fig. 10, or a simple fall as in Fig. 1.

2.4.2. Prosodic syntagms

Prosodic syntagms are characterized by the realization of rather large melodic contours located on their last stress group and realized either 1) by a rising melodic contour on the last stressed syllable of the prosodic syntagms (Fig. 3, 5, 8) or 2) by a flat of slightly falling melodic contour on the stressed syllable and a sharp rising melodic contour on the last syllable (Fig. 7). If the last syllable is also stressed, both melodic movements (flat-falling and rising) take place on the syllable. The second possibility is mostly found in large (i.e. containing many stress groups) prosodic syntagms (Martin, 2004).

As in read speech, the first stress syllable usually carries a rising contour. Inside the prosodic syntagms, if there is no sub grouping of stress groups, the prosodic events are neutralized and realized as flat or slightly falling melodic contours (parenthesis of Fig. 4).

2.4.3. Parentheses

Text parentheses can be associated with an independent prosodic structure or be prosodically integrated with the overall sentence prosodic structure. In the first case, the final contour is falling, as it would be the case in a declarative nucleus (Fig. 4), in the second, the final contour would be rising as in prosodic syntagms.

2.4.4. Postfixes and Suffixes

Postfixes carry a sequence of flat melodic contours. There are no realizations in our example.

Suffixes are associated with a standard declarative (interrogative) prosodic structure. Their terminal contour is thus falling (rising). In this case, the text can be associated to more than one complete text nucleus which usually results from an addition brought by the speaker after the first prosodic structure is ended. Usually, a conjunction is used for the first element of this addition in order to indicate a syntactic relationship with the units of the text nucleus that precedes. No suffixes were found in the example.

3. Detailed analysis: how the prosodic structure reshapes the text

We can now look in details into the characteristics of the prosodic syntagms reshaping the text.

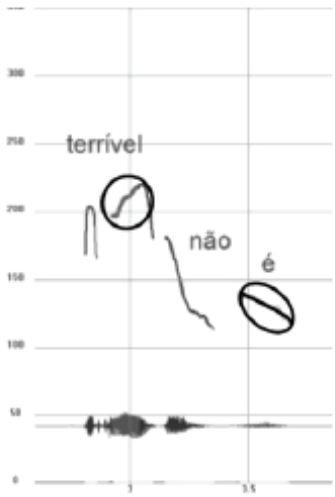

Fig.2. *terrível não é*

Fig. 2 shows a simple configuration: a final falling contour on the stressed syllable (which is also in final position, but no rise can be observed as there is only one short syllable), and a first stressed syllable with a high and rising contour. The text and the prosodic nuclei right boundaries are of aligned on the last stress of the text, *é*.

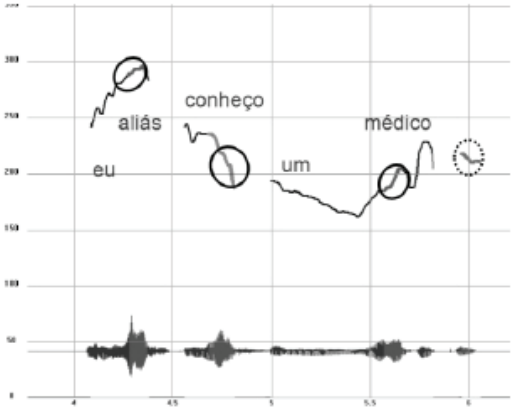

Fig. 3. *eu aliás conheço um médico*

Fig. 3 displays the melodic curve of a prosodic syntagm ended by a continuity contour of the first variety: the stressed syllable *me-* of ***mé****dico* bears a rising melodic contour, whereas the final syllable *–co* shows a rather flat melodic variation (circled in dotted line). The first stressed syllable (in *a****liás***) carries a high and rising contour as observed most often in read speech, whereas the intermediate stressed vowel on *co****nhe****ço* carries a falling contour. This pattern *High Rise*, *Low Fall*, *Low Rise* is typical of both Brazilian and European Portuguese either read or spontaneous (Martin, 1999, 2004).

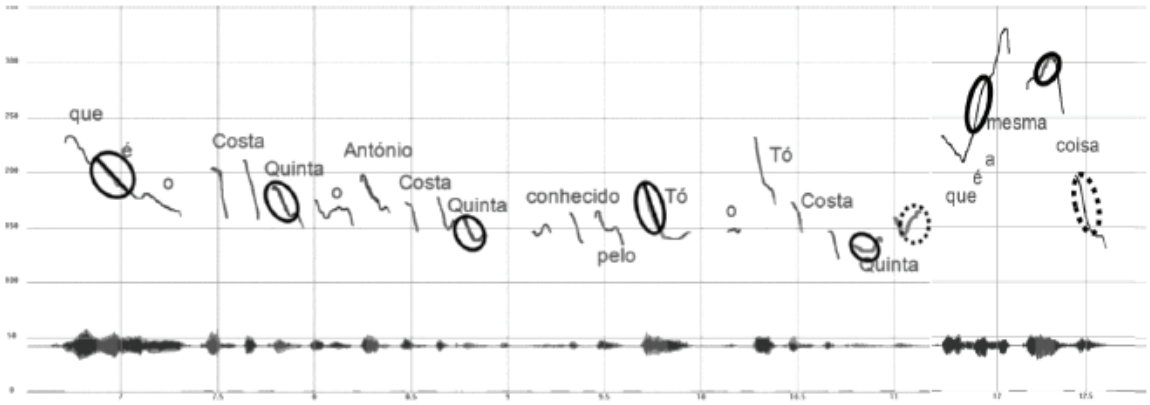

Fig. 4. *que é o Costa Quinta o António Costa Quinta conhecido pelo Tó o Tó Costa Quinta que é a mesma coisa*

Fig. 4 shows a long prosodic parenthesis: *que é o Costa Quinta o António Costa Quinta conhecido pelo Tó o Tó Costa Quinta que é a mesma coisa* with a final declarative conclusive contour, instantiated by a rising contour on the stressed syllable ***coi*** and a sharp falling contour on the last syllable of *coisa*. This realization indicates that the text parenthesis is aligned on an independent prosodic structure. The 3 macrosegments of the text parenthesis *que é o Costa Quinta # o António Costa Quinta conhecido pelo Tó o Tó Costa Quinta # que é a mesma coisa* are thus prosodically merged.

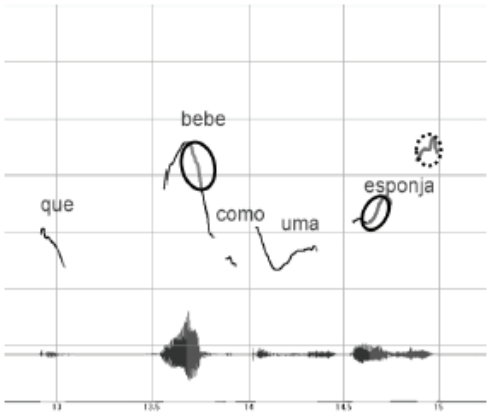

Fig. 5. *que bebe como uma esponja*

Fig. 5 presents the next prosodic syntagm, ended by a rising contour on the last word stressed syllable *es**pon**ja* (type 1). The first stressed syllable is realized with a falling contour.

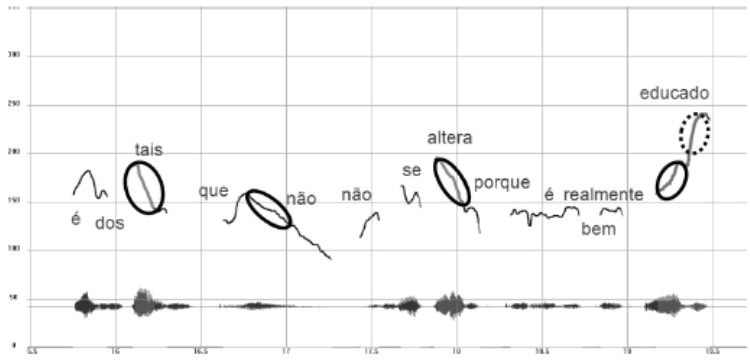

Fig. 6. *é dos tais que não não se altera porque é realmente bem educado*

Fig. 6 shows a prosodic syntagm ended by a complex type 1 melodic contour. The first stressed syllable has a falling contour as in Fig. 5.

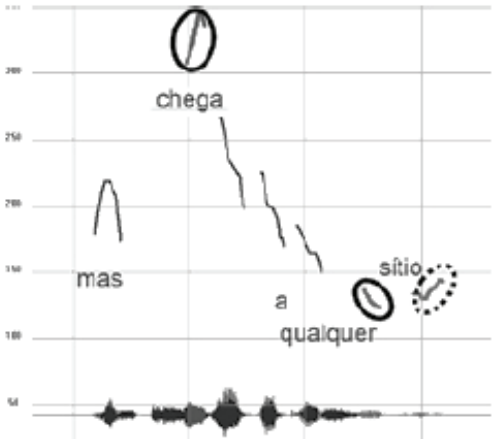

Fig. 7. *mas que chega a qualquer sítio*

Fig. 7 displays a short prosodic syntagm, ended this time by a type 2 complex contour (falling on the stressed syllable and rising on the last syllable). The first stressed syllable on ***che**ga* bears a rising contour.

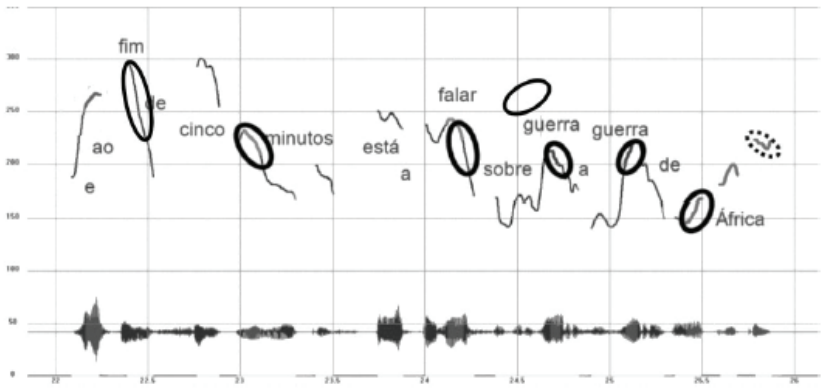

Fig. 8. *e ao fim de cinco minutos está a falar sobre guerra a guerra de África*

Fig. 8 shows a prosodic syntagm started by a rising contour and ended by a type 1 complex contour. All stressed syllables in between carry falling contours, at the exception of the stressed syllable of the reformulated stress group *a Guerra*. The first stress carries a falling contour as in the preceding syntagms.

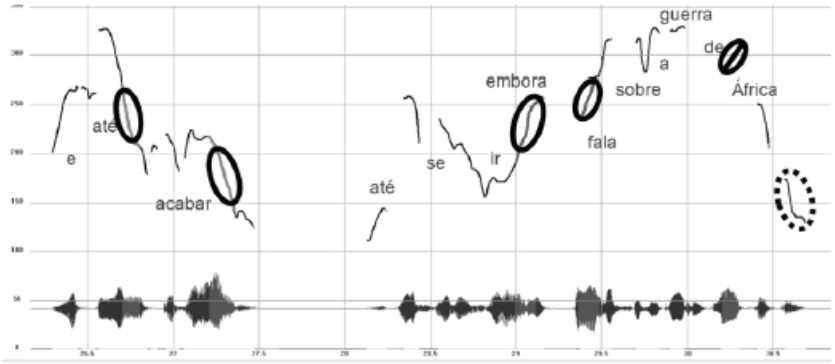

Fig. 9. *e até acabar até se ir embora fala sobre a guerra de África*

Fig. 9. The final prosodic syntagm of the sentence ends with a rising contour on the stressed syllable, and a falling contour of the last syllable of *África*. This conclusive complex melodic movement can be found in other Romance languages (except French).

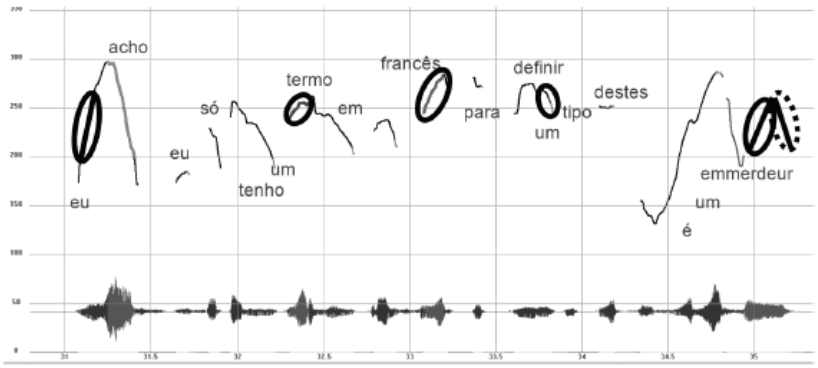

Fig. 10. *eu acho eu só tenho um termo em francês para definir um tipo destes é um emmerdeur*

In Fig. 10, the two text macrosegments prenucleus and nucleus *eu acho eu só tenho um termo em francês para definir um tipo destes* and *é um emmerdeur* are integrated into one sigle prosodic nucleus. The continuity contour expected on *destes* is simply not realized. We retrieve a complex rise fall movement on the last and stressed syllable of *emmerdeur* (a word borrowed from French). This rise fall pattern is normally placed on two distinct syllables, the stressed and the last ones as shown in Fig. 9.

4. Some conclusions

The following conclusions can be drawn from the analysis of this short European Portuguese example:

1. The contour ending the prosodic structure and the nucleus shows a flat or moderate melodic rise on the last stressed syllable, and a sharp fall on the last (unstressed syllable). These rise-fall melodic movements occur on the same stressed syllable in final position;

2. Rising contours with large melodic excursion occur only at the beginning of a new sentence. The first contours of the first prosodic syntagm in the sentence are generally falling. This may indicate the possible role of a rising contour at the beginning of a sentence as a signal of the advent of a new sentence;

3. Inside prosodic nuclei, stressed syllables are marked with very limited range usually falling contours (typically in the 20-30 Hz range). Contrasts between prosodic contours are neutralized;

4. Complex contours ending prosodic syntagms (flat or slightly falling on the stressed syllable and

sharply rising on the final syllable) observed in read speech are not frequently used by this speaker, and occur only to mark the end of a relatively long sequence;

Detailed analysis of prosodic data show that speaker GRA uses efficiently the melodic resources at hand, to mark in a hierarchical way boundaries of macrosegments: the highest level macrosegments in the overall sentence structure are marked by complex contours of types 1 and 2, then at a lower level by rising contours of large amplitude, whereas inside macrosegments, stress groups are marked by limited range melodic fall, and occasionally at a even lower level by a melodic rise. An effect of inverted melodic slope can also be observed in the last prosodic syntagm for the intermediate stress groups that precede the conclusive stress of the prosodic nucleus.

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