Prosody and sentence disambiguation in European Portuguese*

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Abstract

Our investigation focuses on several types of structural ambiguity in European Portuguese. The materials include sentences with set-divider adverbs ambiguous as to the direction of syntactic attachment, adjunct and complement PPs ambiguous as to the level of syntactic embedding, non-restrictive clauses with local and non-local possible antecedents, and relative clauses ambiguous as to their restrictive/non-restrictive meaning. Besides providing a prosodic description of sentences with these various sorts of ambiguity, the relation between prosody and syntactic structure is addressed. It is concluded that structural ambiguity is not always cued by prosody, and it may be resolved by prosodic means that are optional. Additionally, some options on sentence partition in intonational phrases are only available under some interpretations, and in specific configurations I-breaks may not be inserted (namely, between a head and an adjacent complement or modifier). In all cases studied intonational phrase level properties play a crucial role in sentence disambiguation. An intonational phrase boundary after set-divider adverbs indicates left-attachment and between a constituent and the preceding material implies non-local attachment. These facts are seen to follow in a principled way from the conditions on the formation of intonational phrases.

Key words: Prosody, intonation, prosodic phrasing, syntax-phonology interface, disambiguation.

1. Introduction

In the past fifteen years a number of studies on sentence prosody in European Portuguese (EP) has come into light (e.g. Viana 1987, Frota 1991-2002, Falé 1995, Vigário 1997a, 1997b, 1998, Grønnum and Viana 1999, Mata 1999). Many of these explicitly address the relation between prosodic marking (e.g. phrasing and intonation) and sentence meaning (in particular, Frota 1991, 1993, 2000, 2002, Falé 1995 and Vigário 1997a, 1997b, 1998). Despite this, the specific prosodic means

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responsible for disambiguation and the structures that may be prosodically disambiguated are still largely unstudied in EP. This article is intended as a contribution to this line of research.

The ways prosody may contribute to sentence meaning are of various types.

Given that prosodic structures are built to a certain extent on the basis of (some) syntactic information, prosodic constituency may, although do not have to, reflect distinct syntactic structures. A typical example where prosody cues distinct syntactic structures is the contrast between restrictive and non-restrictive clauses reported to exist in many languages.[1]

Other ways in which prosody may contribute to sentence interpretation result from pitch accent and boundary tone choices. Two cases of this type are the distinction between broad and contrastive focus and between declaratives and yes-no interrogatives in EP. Focus assignment in affirmative sentences was extensively studied in Frota's work (Frota 2000, 2002). Regardless of further consequences of focus assignment in early nuclear position, Frota shows that broad and contrastive focus in sentence final position are minimally distinguished by means of a different pitch accent association: the head of the constituent to which broad focus is assigned bears the nuclear pitch accent HL*, while if it is assigned contrastive focus it bears the accent H*L instead (see the example in (1) based on Frota 2000).

(1) a. As angolanas ofereceram especiarias aos jornalistas
| | \
H HL* L%
'The Angolans gave spices to the journalists'

b. As angolanas ofereceram especiarias aos jornalistas
| | \
H H*L L%
'It was to the journalists that the Angolans gave spices.'

Corroborating the general description of yes-no questions in Viana (1987), and the suggestions in Vigário (1998) on the nature of the contrast between declaratives and yes-no questions, Frota (2002) empirically shows that declaratives and yes-no questions may minimally contrast because of boundary tone choice, and makes more precise the form of the question boundary tone. This is illustrated in (2).

1. It may be the case, however, that the specific prosodic phrasing that results from the mapping of such syntactic structures involves prosodic constituents that optionally have no phonological reflections in a given language. For example, it is known that ϕs are not necessarily prosodically marked in EP (e.g. Frota 2000, Vigário 1998), thus, in principle, it could happen that distinct syntactic structures that are prosodized so that their difference resides in ϕ-level partitions become prosodically neutralized. However, it is also possible that in such cases ϕs are obligatorily marked. Our discussion in section 2 suggests that the latter hypothesis is probably the correct one, at least in EP.

(2) a. O poeta cantou uma manhã angelical.

| | | \
H HL* L%

'The poet sang an angelic morning.'

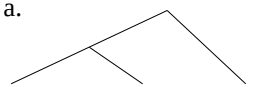
b. O poeta cantou uma manhã angelical?

| | | \
H HL* LH%

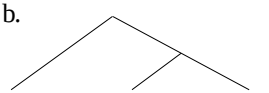
'Did the poet sang an angelic morning?'

Prosody has been shown to play a crucial role in sentence interpretation in other areas, as well. For example, Ladd (1992, 1996) points out that multiple coordinated sentences with distinct syntactic organization, may be differently interpreted depending on the prosodic grouping that is obtained via prosodic compounding at the intonational phrase level. Here phrasing facts are hold to be responsible for differences in meaning, although they are not expected under (classical) prosodic phonology models.[2] The representations in (3) illustrate one such type of ambiguity.

(3) a.



b.



Prieto (1997) shows that intonational breaks may also contribute to the disambiguation of left- and right-branching structures in Catalan. Thus, an ambiguous sentence like the one in (4) is interpreted as (4a) if an intonational break is placed after the subject *la vella*, while it is ambiguous if an intonational break follows the word *llança*, which may be a verb (like in the interpretation in (4a)) or a noun (like in the interpretation in (4b)).

(4) La vella llança l'amenaça
a. 'The old lady threatens him/her' (lit. the old-lady throws the-threat)
b. 'The old lance threatens him/her'

Various prosodic means (prominence, phrasing and accent type, depending on the language) may contribute to the choice of structurally ambiguous syntactic structures in the case of compound and syntactic phrase contrasts as well (e.g. Venditti, Beckman and Jun 1996, Vigário 2003). For instance, stress facts distinguish between compounds and syntactic phrases in languages like English or Dutch (see also Booij 1995, Nespor 1999, among others). Example (5), from Venditti et al. (1996), illustrates this point for English.

2. Similar contrasts are studied in Falé (1995) for EP.

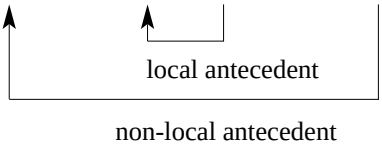
(5) Syntactic phrase: a yéllow jácket
Compound word: a yéllowjacket (=«hornet»)

Prosodic facts have also been reported to be crucially involved in cases of anaphoric antecedent disambiguation in English (e.g. Dogil, Kuhn, Mayer and Rapp 1997, Venditti, Stone, Nanda and Tepper 2002). For example, in a sentence like (6), from Venditti et al. (2002), if a pitch accent is assigned to the pronoun *he*, its antecedent becomes necessarily interpreted as *Bill*, unlike when it bears no pitch accent, in which case its antecedent corresponds to *John*.

(6) John hit Bill and then he hit George

Fodor (2002) shows how the insertion of prosodic breaks before a restrictive relative clause may influence the identification of its antecedent when more than one constituent may play such a role. In a sentence like (7), which is structurally ambiguous as to the antecedent of the relative clause, speakers will tend to prefer the interpretation where the relative clause attaches to the higher (non-adjacent) N', rather than to the lower (adjacent) N', if a prosodic break intervenes between the relative clause and the preceding potential antecedent.

(7) Someone shot the servant of the actress who was on the balcony



In this paper, we will focus our attention on a subset of structurally ambiguous sentences. We will address several sorts of syntactic attachment ambiguities in EP. Specifically, we will study the prosodic cues to mark (i) the direction of attachment of set-divider adverbs (section 2), (ii) local versus non-local attachment of adjunct PPs (section 3.1), of complement PPs (section 3.2) and of non-restrictive relative clause (section 4.2), as well as (iii) the distinction between restrictive and non-restrictive relative clauses (section 4.1). Our goal is to determine whether prosody may contribute to the disambiguation of the structures under observation, describe the specific prosodic cues that might be involved, and assess in what ways these may be related to (syntactic) structural information. We will show that (i) structural ambiguity is not always necessarily resolved by means of prosodic phrasing; (ii) structural ambiguity may be resolved by means of *optional* prosodic phrasing, and this may be captured by the conditions on prosodic domains formation.

2. Background

We adopt the general approach to prosodic phonology developed in Selkirk (1984, 1986), Nespor and Vogel (1986), Truckenbrodt (1999), inter alia, and the basic

tenets of intonational phonology as expressed in Pierrehumbert and Beckman (1988) and Ladd (1996). We follow Hayes and Lahiri (1991), Grice (1995), Frota (2000), among others, in the assumption that tonal association refers to prosodic constituents as defined in the prosodic phonology framework (see the references above) rather than metrical-like units (e.g. Viana 1987), or some other sort of constituents.

We assume the algorithms for the construction of phrasal prosodic domains proposed by Frota (2000) for EP and presented in (8) and (9), together with the phonological conditions to which these prosodic domains are subject (see (10) and (11), respectively).

(8) *Intonational Phrase (I) Formation (EP)*
  a. I-domain: the domain of I-formation may consist of
    i. all the ϕs in a string that is not structurally attached to the sentence tree,
    or ii. any remaining sequence of adjacent ϕs in a root sentence.
  b. I-construction: the constituents included in an I must bear a head/complement relation.

(9) *Weight conditions on Is (EP)*: long phrases tend to be divided; balanced phrases, or the longest phrase in the rightmost position, are preferred.

(10) *Phonological Phrase (ϕ) Formation (EP)*
  a. ϕ-domain: The domain of ϕ-formation is defined by the configuration [… Lex XP …]$_{Lex^{max}}$;[3]
  b. ϕ-construction: Elements around Lex are organized into ϕs so that
    i. all elements on the non-recursive side of Lex which are still within Lex^{max} are contained in the same ϕ with Lex;
    ii. a ϕ may optionally contain (i) and a following phrase in the domain of (a).

(11) *Branchingness (or weight) condition on ϕs (EP)*: a ϕ should contain more material than one prosodic word.

For the discussion that follows a word is also required on the prosodic properties that are known to characterize ϕs and Is in EP.

The intonational phrase is richly marked in EP. It is the domain of tune association, which is minimally composed of a nuclear pitch accent and a boundary tone (Frota 2000, 2002); it displays final lengthening and determines the locus of pause insertion (Frota 2000: chap.4); it defines the upper limit for the application of many phonological processes (Frota 2000: chap. 2) and, more in general, it bounds resyllabification (Vigário 2003); it is the domain of the optional process

3. Where *Lex* stands for a lexical head and *Lex^{max}* for the maximal projection of a lexical head (see Frota 2000).

of initial non-primary stress assignment (cf. Frota and Vigário 2000); and its prominent element is well perceived.

The phonological cues for the phonological phrase are not as clear since there are no sandhi rules bound by this constituent, and a ϕ that is not the head of an intonational phrase is not necessarily assigned a pitch accent and its head is often not perceived as prominent. Nevertheless, a number of phonological facts depend on this domain. For instance, clash resolution processes are dependent on f-level prominence relations (cf. Frota 2000a: chap.3); pitch accent distribution is conditioned by ϕ level prominence, since pitch accents are primarily assigned to the head of a ϕ-phrase (cf. Vigário 1998, Frota 2000a: 4.2.2); register shift is a domain-limit process at the level of ϕ (it only occurs across, but not within, ϕs—cf. Vigário 1997a, 1997b, 1998: 6.2.3.4).[4]

3. Direction of attachment: the modifee of set-divider adverbs

The scope of adverbs like *apenas, só, somente* 'only', called 'set-dividers' in Ernst (1984), and its prosodic reflections in EP was studied in Vigário (1997a, 1998).[5] In this section, we will focus on the materials presented in these works that concern the type of structural ambiguity illustrated in (12) (where a simplified syntactic bracketing is also given[6]). Although in both sentences the adverb is in the same linear position, between the subject and the verb, in (12a) it modifies the constituent to its left—the subject—whereas in (12b) it modifies the constituent to its right—the verb or the verb phrase.

(12) *As garotas apenas emprestaram filmes às amigas*

a. $[\text{As garotas apenas}]_{NP}$ $[\text{emprestaram } [\text{filmes}]_{NP} [\text{às amigas}]_{PP}]_{VP}$
'Only the girls have lent films to their friends'

b. $[\text{As garotas}]_{NP}$ $[\text{apenas } [\text{emprestaram } [\text{filmes}]_{NP} [\text{às amigas}]_{PP}]_{VP}]_{VP}$
'The girls have only lent films to their frinds (i.e. they have only done that)'

These sentences are prosodically differentiated. There are at least two ways of obtaining the reading in (12a). The noun in subject position and the adverb may form an independent intonational phrase: the adverb is assigned a nuclear pitch accent, a boundary tone and an acoustic pause mark the I boundary, and the fol-

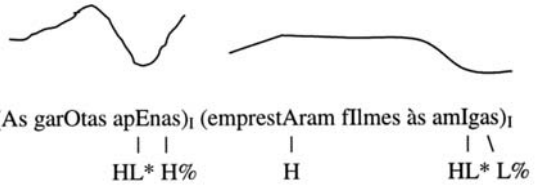
4. Phonological weight requirements on some syntactic constructions are also defined with reference to ϕ—for example, topicalization requires that the I-phrase that includes the clause from which a topicalized phrase is extracted has a heavy head (where a heavy head is defined as a ϕ that either bears focus or is branching —cf. Frota and Vigário 1996, 2002).

5. A total of 55 sentences with the adverb in various positions produced by two speakers in a reading task were analyzed. All F0 contours can be found in (Vigário 1998: Anexo II). A perception task by 6 subjects allowed the assessment of the interpretation of each sentence produced.

6. The syntax of adverbs is a matter of great controversy (see, for example, the review in Costa 1998: chap. 2). For our purposes, the specific details of the syntactic analysis of set-divider adverbs is not relevant, as long as these adverbs are always within the maximal projection of the category they modify.

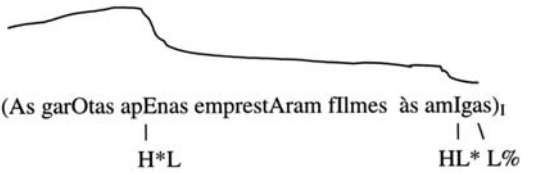
lowing material is contained within an independent intonational phrase, as illustrated in (13). Alternatively, the adverb is focused, in which case it is assigned the focus pitch accent (H*L), and the tonal space to the right is narrowed, as depicted in (14) (stressed vowels are in capitals). In both cases, the modified constituent never bears pitch accent.

(13)



(Vigário 1998: 243 (114))

(14)



(Vigário 1998: 243 (116))

If the adverb modifies the VP, as in (12b), no special prosodic marking is required and the sentence may be realized just like any neutral declarative sentence without internal pitch accents: the whole sentence forms a single intonational phrase, as an initial H tone is aligned with the right edge of the first prosodic word of I, an HL* is associated with the last prominent syllable of the intonational phrase and an L% is associated to the right-edge of I (see the example (197) in Vigário 1998: 238).

If the adverb occupies other positions in the sentence and modifies the constituent to its right, several possibilities of prosodic marking arise, besides the one described in the previous paragraph: (i) a pitch accent may be assigned to the modified element, which corresponds to the head of its ϕ-phrase, and in that case the adverb may also be assigned a pitch accent; (ii) the modified element may be focalized; or (iii) the adverb becomes the head of the ϕ-phrase that also contains its modifee and only the adverb is assigned a pitch accent. This is summarized in (15), where we mark pitch accent association (T* stands for pitch accent) and the prominence relations within ϕ (*w* and *s* stand for *weak* and *strong*, respectively, and *S* for focus prominence—see Frota 2000).

(15) a. Adv Modifee b. Adv Modifee c. Adv Modifee
(*w* *s*)ϕ (*w* *S*)ϕ (*s* *w*)ϕ
| | | |
(T*) T* T* T*

Common to all the cases in (15), where the adverb modifies the constituent to its right, is the obligatory presence of a pitch accent associated to the head of the preceding phrase.

To sum up so far, when the adverb modifies the preceding constituent, the adverb is always the prominent element of the I that contains the two and the preceding constituent never bears a pitch accent, whereas when the adverb modifies the following constituent it is never the head of its I and the prominent element of the preceding ϕ always bears a pitch accent. The relevant aspects of prosodic marking associated to each reading are summarized in (16) and (17).

(16) (X) Modifee Adv Y or (X) Modifee Adv Y
(…. *w* *s*)$_I$ (…….)$_I$ (…. *w* *S* ….)$_I$
| |
--- T* … --- T* ...

(17) a. X Adv Modifee (Y) b. X Adv Modifee (Y)
(… *s*) (*w* *s*)$_\phi$ … (… *s*) (*w* *S*)$_\phi$ …
| | | | |
T* (T*) (T*) T* T*

c. X Adv Modifee (Y)
(… *s*) (*s* *w*)$_\phi$
| |
T* T*

Let us now investigate in what ways these prosodic facts are related to the prosodic structure, which is partially dependent on structural syntactic information.

In order to determine the prosodic structure of the sentences involving these adverbs we must know if they count as lexical heads for the purpose of prosodic tree construction. Nespor and Vogel (1986:169) propose that only lexical categories that have at least one positive specification in the categorial feature system are relevant for ϕ construction. Given that adverbs are not among the set of categories specified with categorial features (which only includes nouns, verbs, adjectives and prepositions), it is not clear what is their status for the purpose of ϕ construction. Nevertheless, adverbs are part of the set of major lexical categories and are the nucleus of phrasal categories (e.g. Raposo 1992). Furthermore, some examples taken from Nespor and Vogel (1986: 170) suggest that adverbs may function like lexical heads (as in *(piú attentamente)*$_\phi$) and may even be the only members of their ϕs (as in *(completamente)*$_\phi$).

If we consider set-divider adverbs, it seems necessary to allow these units to form a phonological phrase together with the following lexical head. However, this should only happen when that head corresponds to the modified constituent, since otherwise the adverb and the lexical head obligatorily belong to separate ϕs. Thus, these adverbs display a behavior similar to that of adjectives in Romance languages, because their status as lexical heads for the purpose of ϕ construction depends on

the position they occupy relative to the modified element. (See Nespor and Vogel 1986:169, according to which adjectives in Romance count as lexical heads when they follow the modified noun, but not when they are placed on its non-recursive side).

Assuming that adverbs, like adjectives in Romance, count as lexical heads only when they follow the constituent they modify and adopting the algorithm for ϕ construction presented in section 1, the sentences above are assigned the prosodic structure in (18). In (18a), the adverb is on the right side of the modified constituent (the subject). However, even if it has the status of a lexical head, it constitutes a non-branching ϕ. Thus, it must form a phonological phrase together with the preceding noun that it modifies (see the conditions on EP ϕ formation in (11) above). In (18b), the adverb modifies the constituent to its right (the verb or the whole VP). Therefore, it does not count as a lexical head for the purpose of ϕ construction, and thus it must be part of the phonological phrase headed by the verb.

(18) a. $(\text{Os rapazes apenas})_{\phi}$ $(\text{emprestaram livros})_{\phi}$ $(\text{às raparigas})_{\phi}$
'Only the boys have lent books to the girls'

b. $(\text{Os rapazes})_{\phi}$ $(\text{apenas emprestaram livros})_{\phi}$ $(\text{às raparigas})_{\phi}$
'The boys have only lent books to the girls'

Given this prosodic structure, in a language like EP, where non-final ϕs are not necessarily prosodically marked, it could be the case that the two readings would end up non-distinguished prosodically. However, this does not happen. When a sentence like (18a) is realized in such a way that the prosodic break between the adverb and the following constituent is not clear, speakers interpret the adverb as a modifier of the following constituent (cf. Vigário 1998: chap.4). The conclusion we may draw from this is that the prosodic features that render the phonological phrase visible are not optional when two different readings originate from two distinct syntactic structures that yield different prosodic phrasings.

Another aspect we would like to discuss concerns the prosodic means used to mark prosodic structure. We have seen that when the adverb modifies the *preceding* constituent, either an intonational break follows the adverb or the adverb is focalized. In the first case, the I boundary may be seen to result from the need to strengthen the prosodic break between the adverb and the following constituent (recall that, unlike the intonational phrase, the phonological phrase in EP is not always prosodically marked—see section 1). In other words, the I-level boundary reinforces the prosodic delimitation that is relevant for disambiguation. In the second case, however, assigning focus to the adverb does not seem to contribute to the prosodic delimitation of the relevant constituents. In fact, Frota (2000) has shown that, unlike in other languages, focus does not introduce prosodic boundaries in EP.[7] We would like to suggest, nevertheless, that in an indirect way focus

7. According to D'Imperio and Fivela (to appear) there is no evidence for the presence of a prosodic boundary induced by narrow focus in Italian either.

does contribute to such delimitation in cases like the ones under discussion. We develop this idea in the next paragraphs.

We have seen above that when the adverb modifies the constituent to its *right*, the modified constituent may be focalized. Focus on the adverb, however, is impossible. Notice that the adverb in this configuration may be the prominent element of its ϕ: it may be perceived as prominent and be assigned the only pitch accent of the ϕ that also contains the modified constituent. This does not imply, however, that in such cases the adverb is focalized: it is not perceived as such, the pitch accent that is assigned to it is not H*L (the focus pitch accent), the tonal space for the realization of the following pitch accents is not narrowed. The question we would like to ask then is why the adverb may bear focus in one case but not the other.

That these adverbs may bear focus—when they modify the preceding constituent— may be explained by the fact that the interpretation of this type of words is dependent on focus assignment (e.g. Jackendoff 1972, Köning 1991). Nevertheless, its relation to focus is present whether it precedes or follows the modified constituent. In order to explain the asymmetry observed, we propose that focus may only be assigned to lexical words that (are in a position where they can) function as lexical heads for the purpose of prosody. In this way we predict that nouns and verbs may be focused regardless of their position, but neither adverbs nor adjectives should be allowed to bear focus when they appear on the non-recursive side of the constituent they modify. This prediction is confirmed for negative adverbs, which according to Vigário (1997b, 1998) may bear ϕ prominence and be perceived as prominent, but may not bear I prominence and be perceived as focused.[8] The rational behind our proposal is that this sort of words in such weak positions behave like function units, which may not be focalized either.

Given the preceding assumption, we may now address the question raised above. If it is correct that focus may only be assigned to words that may function as lexical heads, when the adverb bears focus it must occur to the right of the modified constituent. In other words, the presence of focus in these specific cases contributes to the identification of prosodic structure.

As a general conclusion, the type of structural ambiguity illustrated in this section is resolved by prosodic means that, directly or indirectly, cue prosodic constituency.[9] Interestingly, although in theory it is possible to disambiguate the sentences under analysis on the basis of ϕ-level phrasing, we have noted a consistent tendency for promoting relevant ϕ-boundaries to I-level boundaries, which is prob-

8. Frota (2000) shows that nouns that are included in the same ϕ as a following adjective may be focused (e.g. *MANHÃ âmbar* 'morning amber'). According to our hypothesis, it is not a coincidence that in all her examples with focus on the adjective, the adjective is to the right of the modified noun and not to its left.

9. For Jackendoff (1972), non-directional attachment of adverbs like *only* is not available in English. However, Köning (1991) reports that this configuration is possible provided that the adverb is assigned the nuclear stress. Regardless of further details on the prosodic marking associated to these structures, English thus seems to pattern like European Portuguese, since, either by virtue of bearing focus or by appearing in the final position of its intonational phrase, in EP too the adverb always ends up with a nuclear stress in this position.

ably a consequence of the fact that the latter are more clearly marked than the former.

4. Depth of syntactic embedding: PP attachment

Another type of ambiguity obtains when a constituent in the same linear position may be syntactically attached to XPs with different syntactic heights. In this section we discuss two cases where a PP may either attach to a lower or a higher node, as illustrated in sentences (19-20): in (19) the PP may either be adjoined to the preceding NP or to the VP, whereas in (20) the PP may either be a complement of the preceding noun or of the verb.[10]

(19) A Joana observou o rapaz com os binóculos
'Joana saw the boy with the binoculars'
a. Joana is holding the binoculars
b. The boy is holding the binoculars

(20) Deslocaram-se as populações do interior para o litoral
'They moved people from the inland to the coast'
a. The moved people are from the inland
b. The movement was from the inland to the coast

Our study is based on a reading task performed by three speakers, which consisted of the production of the sentences in (19-20) according to the interpretation suggested by means of a preceding context-sentence (see (21-22), respectively).[11]

(21) a. Joana está com os binóculos
'Joana holds the binoculars'

b. O rapaz tem os binóculos
'The boy holds the binoculars'

(22) a. As populações são do interior
'The people are from the inland'

b. As populações foram deslocadas do interior para o litoral
'The people were moved from the inland to the coast'

10. The ambiguity of sentences like the one in (21) was previously studied in Nespor and Vogel (1986) on the basis of Italian. The second case of ambiguity was first pointed out to me by J. Morais Barbosa (p.c.).
11. In Avesani, Hirschberg and Prieto (1995) potentially ambiguous sentences are also studied. Here, the relevant sentences are embedded in a paragraph with a disambiguating context. Although this procedure appears to favor natural renditions, it has the potential drawback that the resulting productions are not prosodically disambiguated because the context may be «too felicitous». That is, in that case disambiguation may be achieved by non-prosodic means.

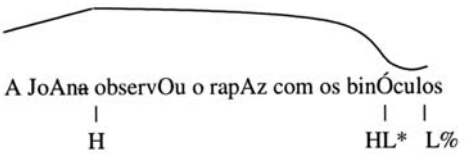
All sentences with the different disambiguating contexts were produced (at least) twice by each speaker.[12] The resulting reading was then assigned by the author in a perception task where all sentences were heard in random order and without access to contexual information. Four other speakers of EP were also systematically questioned on the interpretation associated with the prosodic pattern obtained for each reading.

4.1. Local versus non-local attachment with PP adjuncts

Let us first consider the cases where the PP is an adjunct and modifies either the preceding noun or the whole VP.

In most of the realizations obtained the sentences are not prosodically disambiguated. Essentially, the sentences produced show the prosody of non-ambiguous declarative sentences: the whole sentence corresponds to a single I, with an initial H tone and a final nuclear HL* followed by an L%; the subject NP may optionally form a separate I; and the head of the ϕ that contains the object NP (*o rapaz*) optionally bears a pitch accent. The typical declarative contour is provided in (23).

(23)



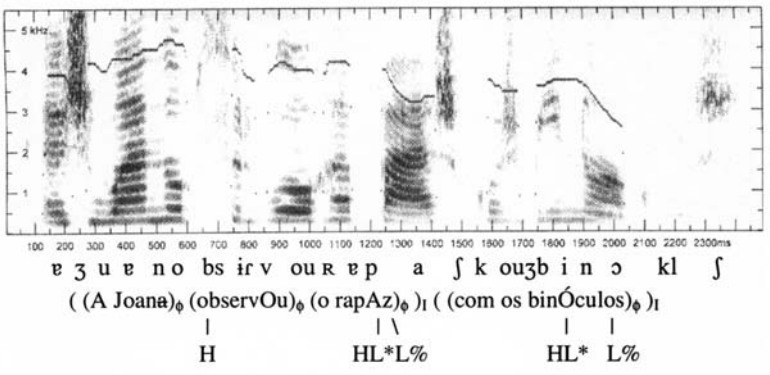
These prosodically ambiguous realizations are expected given the algorithms of construction of prosodic domains, which, if we disregard for the time being the optional breaks at the level of I, result in the same structure for the two readings (see (24)).

(24) ((A Joana)$_{\phi}$ (observou)$_{\phi}$ (o rapaz)$_{\phi}$ (com os binóculos)$_{\phi}$)$_{I}$

There is however one type of realization that yields a non-ambiguous reading, in that the PP is necessarily interpreted as attached to the VP. In this case, there is a prosodic break of a higher level between *(o rapaz)*$_{\phi}$ and *(com os binóculos)*$_{\phi}$: *rapaz* is assigned HL* pitch accent; it is perceived as the prominent element of its I phrase; a perceived pause occurs between the two phrases; *binóculos* is assigned the nuclear declarative HL* pitch accent, which is followed by a boundary L% . This is shown in (25).[13]

12. The number of tokens under analysis in our study is small. Nevertheless, all the productions recorded sound natural and seem to us representative of at least some of the prosodic markings that may be associated to each reading. An exhaustive treatment of these structures is beyond the scope of this paper, as well as frequency considerations of any kind.
13. EP I-phrases consist minimally of a nuclear pitch accent and a boundary tone (cf. Frota 2000). The fact that the first proposed I was not described as having a boundary tone deserves a comment.

(25)



The possibility of disambiguating sentences like those presented above by means of prosodic structure is most interesting given the type of syntactic information that is referred to in the construction of prosodic domains, which does not include the depth of syntactic embedding. Furthermore, the results of a disambiguation test reported in Nespor and Vogel (1986) containing Italian sentences of this same type do suggest that such sentences are not disambiguated through prosodic phrasing.

Before trying to explain the difference between our results and Nespor and Vogel's, we should try to understand why this type of sentences can be broken into two intonational phrases.

It is well-known that I-breaks may be freely inserted in several sentence positions (e.g. Selkirk 1984, 2000, Nespor and Vogel 1986 and, for EP, Viana 1987, Vigário 1998, Frota 2000). In theory, besides the possibility that each ϕ corresponds to a single I, the sentence under discussion could be produced in at least any of the following ways.

(26) a. ((A Joana)$_\phi$)$_I$ ((observou)$_\phi$ (o rapaz)$_\phi$ (com os binóculos)$_\phi$)$_I$
b. ((A Joana)$_\phi$ (observou)$_\phi$)$_I$ ((o rapaz)$_\phi$ ((com os binóculos)$_\phi$)$_I$
c. ((A Joana)$_\phi$ (observou)$_\phi$ (o rapaz)$_\phi$)$_I$ ((com os binóculos)$_\phi$)$_I$

There are, nevertheless, some prosodic breaks that are more likely to occur than others because of syntactic and phonological considerations. For example, the I-break illustrated in (26a) is expected, given that the subject NP and the VP are two major syntactic constituents and the resulting I-phrases respect the phonological conditions on I's (namely, the longest I is on the right—see (9) in section 1). As reported above, this possibility was attested in our data. The break between the verb and the object in (26b) is arguably less probable because it occurs at a minor

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Since *rapaz* ends in a stressed vowel and is assigned HL*, it ends in a low tone. Thus, it is hard to prove on an acoustic basis the existence of an L% associated to the same position. Given that the remaining properties of I are present, we may assume, however, that an L% is also present in this case.

syntactic break and, although the result is a balanced division into I-phrases, the sentence is not that long and thus such a partition is not motivated purely on phonological grounds. Besides this, here the I-break splits up the verb and its adjacent complement, and in such a configuration I-insertion appears to be ruled out by a more general principle, as we will see in section 5 (we return to this possibility below). Now, syntactic and phonological considerations would make it particularly implausible (or even impossible) to divide a sentence like in (26c) under the interpretation that the PP modifies the object NP: here, there is no major syntactic break between the NP and the PP, and the phonological conditions on Is are not respected—the two Is are not balanced, the rightmost I is not the longest constituent and it is in fact a very short one (it contains a single ϕ). Thus, here not only is there no motivation for this particular phrasing but in addition there is a violation of the phonological conditions on the formation of intonational phrases.

Why then an I-break is allowed when the PP modifies the VP? The factor that seems to crucially distinguish the two structures is the depth of embedding of the PP. Only the PP that is attached higher seems to be separable by means of an intonational phrase break. As we will see in the following sections, the signaling by means of an I-break of non-local attachment of constituents whose syntactic attachment is ambiguous is a more general phenomenon, not only in European Portuguese, but also in other languages (see sections 3.2, 4.2 and 5, and Fodor 2002).

Let us now return to the Italian data in Nespor and Vogel (1986). We believe that Italian is not necessarily distinct from EP in this regard. The fact that in their experiment similar sentences were not prosodically disambiguated may simply follow from a methodological difference between Nespor and Vogel's experiment and ours. Although the interpretation of each sentence was tested with several subjects in Nespor and Vogel's work, a single speaker produced all sentences and only once. Therefore, if the relevant sentences were not uttered so that the crucial PP corresponds to a separate IP, they are indeed expected not be disambiguated.

Our interpretation of the facts is corroborated by the data in Avesani, Hirschberg and Prieto (1995), who have studied similar cases of prosodic disambiguation of VP and NP attachment of prepositional phrases in Italian. The results reported are in fact close to those described above for EP, in that sentences where the PP is attached to the VP, but not to the NP, were produced (in this case by all speakers) with an intonational phrase break before the PP.

We should notice, additionally, that among the possibilities of I insertion in (26) above, there is one that is not attested in our data or reported in Avesani et al. (1995), but that could be thought to be used for disambiguation purposes as well. Despite the implausible character of the break illustrated in (26b) that was mentioned above, it is very clear that here only the reading where the PP is attached to the NP, but not to the VP, is possible. We may account for this in a straightforward way under the Sense Unit condition of Selkirk (1984: 291), stated in (27).[14] Given

14. The Sense Unit condition is embodied in Frota's (2000) definition of I-construction (see (8b) in section 1).

this condition, only in the former case does the I that contains the NP and the PP form a sense unit, since only here is the PP a modifier of the NP.

(27) Two constituents Ci and Cj form a sense unit if (a) or (b) is true of the semantic interpretation of the sentence

(a) Ci modifies Cj (a head)

(b) Ci is an argument of Cj (a head)

In conclusion, optional prosodic bracketing may be exploited for disambiguation purposes. As some optional prosodizations are available only for one of the syntactic structures that yield different meanings, optional prosodic phrasing may be used for disambiguating potentially ambiguous sentences.

4.2. Local versus non-local attachment of PP complements

The second type of ambiguity that we will consider in this section is the one illustrated in (28).

(28) *Deslocaram-se* *as populações* *do interior* *para o litoral*
they-moved the people from-the inland to the coast

a. [Deslocaram-se [[as populações [do interior]$_{PP}$]$_{NP}$ [para o litoral]$_{PP}$]$_{VP}$
(The people that were moved are from the inland)

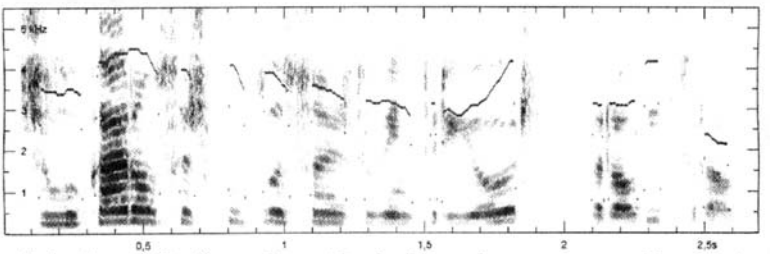
b. [Deslocaram-se [as populações]$_{NP}$ [do interior]$_{PP}$ [para o litoral]$_{PP}$]$_{VP}$
(The people were moved from the inland to the coast)

In our data, there are two types of renditions. One is realized like neutral declarative sentences and the resulting sentence is ambiguous: the initial H-tone is associated with the posttonic syllable of the first word of the sentence and the nuclear pitch accent HL* is assigned to the last stressed syllable of the I-phrase, followed by an L%. In most productions, however, there is a prosodic difference that correlates with the different meanings. When the PP is a complement of the preceding N, it obligatorily belongs to the same I-domain as the N, and the ϕ that contains the PP, but not the one that contains the N, bears a pitch accent. Besides this, the two ϕs are phrased together within an I-phrase distinct from the one that includes the second PP, which is assigned a nuclear pitch accent and a boundary tone (as illustrated in (29)).[15] When the PP is a complement of V, by contrast, *populações* always bears a pitch accent and is perceived as having ϕ-level prominence. The ϕ that contains the following PP is also obligatorily pitch accented, in the same way as the last PP. A prosodic break is perceived between the object NP and the following

15. We should point out, nevertheless, that although the favored interpretation in this case is the one where *[do interior]* is a complement of the noun, the PP may also be interpreted as a complement of the verb. Our judgements have been confirmed by four other speakers of EP.

PP, and the two PPs may either form two independent I-phrases or a single one (see the illustration in (30)).

(29)

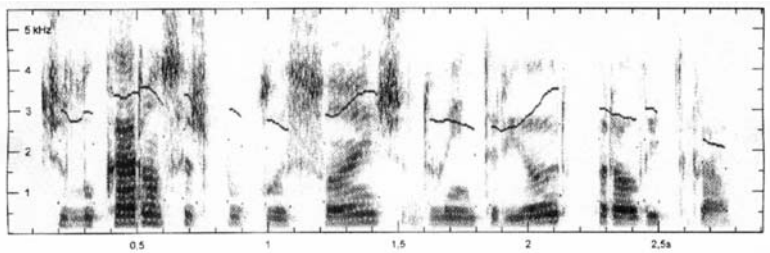


dʒ l u k a ɾɐ̃w̃ sɐʃ pu pl ɐ s õj̃ ʒdwɪ̃ tɾ io ɾ pɐɾɔ l i t ɾ aɬ

(DeslocAram-se as populaçÕes do interiOr)$_I$ (para o litorAl)$_I$

H	----	L*HH% HL*L%

(30)



dʒ l u k a ɾɐ̃w̃ sɐʃ pu pl ɐ s õj̃ ʃ d u ɪ̃ tɾ i o ɾ pɐɾ ɔ l i t ɾ aɬ

(DeslocAram-se as populaçÕes)$_I$ (do interiOr)$_I$ (para o litorAl)$_I$

H	L*HH%	L*HH%	HL*L%

We should make precise that in both cases, the evidence for I-phrase level breaks is not always entirely clear. Since in our data we only have acute words at the relevant positions, it is not obvious that a boundary tone occurs. Besides this, although the breaks are clearly perceived, there are no acoustic pauses. Two reasons motivated our analysis here: first, it is clear that the phrasing illustrated in (29-30) is possible and correlates with the difference in meaning; second, under such phrasings the conditions are met for the creation of a compound I-phrase domain (cf. Frota 2000)—the resulting non-initial intonational phrases are very short, as they contain a single ϕ. If a compound I results, it is expected that the non-final Is are prosodically less marked, that is, acoustic pauses are predicted not to occur and the tonal space is expected to be more reduced (see Frota 2000 for a detailed description of the prosodic properties of compound intonational phrases and their internal I's). This analysis may therefore explain why the relevant

prosodic phrases seem to be of a level higher than ϕ but are less marked than (maximal) intonational phrases. It may justify, furthermore, why, when the PP *[do interior]* is a complement of the verb, it may form a single (compound) I-domain with the following PP (*[para o litoral]*): although the two PPs do not form a Sense Unit, as defined above, they may be grouped within a compound I domain.

Like in the case observed in the preceding section, and since the level of syntactic attachment is not part of the syntactic information relevant for the constrution of phrasal prosodic domains, the two sentences under observation are expected not to be prosodically distinguished. Disregarding optional I-level prosodic breaks, the prosodic phrasing of such sentences will be the one in (31).

(31) ((Deslocaram-se)$_{\phi}$ (as populações)$_{\phi}$ (do interior)$_{\phi}$ (para o litoral)$_{\phi}$)$_{I}$

Thus, whether internal ϕs are prosodically marked or not, sentences with the prosodic structure in (31) are predicted not to be prosodically disambiguated. Optional prosodic breaks, however, may be used in order to disambiguate such sentences, as we have already seen. And this is true for other languages as well. For example, Avesani et al. (1995) have found that sentences with the same type of potential ambiguity as the one studied here are also disambiguated by means of prosodic partitions at the I-level in Italian, English and Spanish.

We believe that this sort of disambiguation is not mandatory, since it results from the possibility of introducing optional intonational phrase breaks. The results in Avesani et al. (1995) might be seen to contradict this view, as in Italian and English there is always disambiguation. We think this may not be the case, however. First, because they report that Spanish speakers were *inconsistent* in that two subjects did not disambiguate between the two readings whereas the other two did so. Second, because the experiment in Nespor and Vogel (1986) indicates that ambiguity may remain in Italian as well. Under our approach this is the expected picture. As the I-break that may disambiguate between the two readings is optional, disambiguation is optional as well.

Finally, it should be noticed that in our examples there are no phonological reasons for introducing any intonational phrase breaks. It thus follows that, if such breaks occur, they are most likely to have a syntactic/semantic motivation and thus can be used by listeners when assigning the specific interpretation to this type of sentences.

In conclusion, optional intonational phrase breaks may disambiguate sentences that show attachment ambiguities involving complement PPs. An I-boundary between the PP and the previous adjacent head forces the interpretation whereby the PP is not a complement of that head but rather of a head that occupies a higher place in the syntactic tree. Like in the previous sub-section, we propose this fact to result from the impossibility of introducing an I-boundary between a head and an adjacent complement.

5. Relative clauses

In this section we will consider two types of ambiguity concerning relative clauses. We will focus our attention on the contrast between restrictive and non-restrictive clauses and discuss the contrast between local and non-local antecedent ambiguities with non-restrictive relative clauses.

The procedure followed is similar to that already described in section 3. The tested sentences are those in (32), which were presented to our subjects with the context-sentences in (33). Like before, the sentences were produced by three speakers twice for each interpretation.

(32) a. A amiga da Joana que vive em Coimbra ofereceu rosas ao namorado
'Joana's friend that lives in Coimbra has given roses to her boy friend'

b. A amiga da Joana, que vive em Coimbra, ofereceu rosas ao namorado
'The friend of Joana, who lives in Coimbra, has given roses to her boy friend'

(33) a. A Joana tem uma amiga especial
'Joana has a special friend'

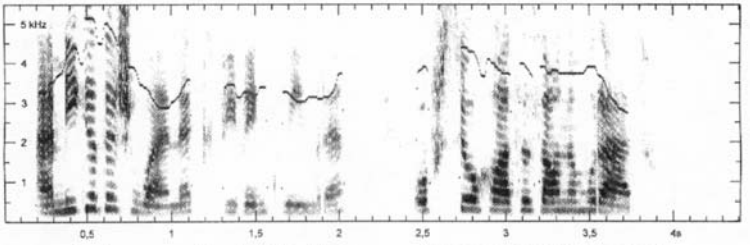
b. A Joana tem imensas amigas
'Joana has lots of friends'

5.1. Restrictive versus non-restrictive relative clauses

It is known that non-restrictive and restrictive clauses are prosodically non-ambiguous cross-linguistically. EP speakers have the same intuition for Portuguese as well but to our knowledge the prosodic correlates of this distinction were never systematically described. Besides this, given that intonational breaks may in general be inserted in several sentence locations, it seems plausible that such contrast can in fact be neutralized by the insertion of an I break between a restrictive clause and its antecedent. The following paragraphs address these issues.

As expected, all sentences containing non-restrictive clauses were non-ambiguous in this regard. The relative clause always forms an independent intonational phrase domain and thus these sentences were always produced with three intonational phrases, separated by (acoustic or at least perceived) pauses: the first I shows an optional H initial tone in the posttonic position of the first word of the phrase, *Joana*, the head of the I that precedes the relative clause, either bears an L*H or an HL* and a boundary tone follows; in all cases the boundary tone is H%, and never L%; the I that contains the relative clause exhibits precisely the same tonal description; and the final I contains the typical final nuclear and boundary tone sequence (HL* L%) and an optional initial H or an HL* may be found in the head of the first ϕ (see the illustration in (34)).

(34)

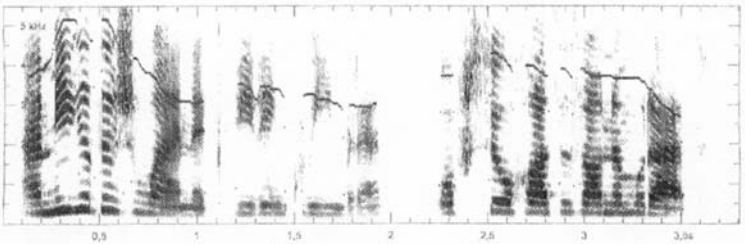


(A amIga da JoAna)$_I$ (que vIve em CoImbra)$_I$ (oferecEu rOsas ao namorAdo)$_I$

| | | \ | | | | | \
H L*H H% HL* H% H HL* L%

Let us now turn to the realization of restrictive clauses. In all cases, there is no pause between the relative clause and its antecedent. The two constituents appear to form a single intonational phrase, which is separated from the rest of the sentence by an intonational phrase boundary and a pause (often acoustic silence). The tonal description of these sentences is as follows: an initial H always aligns with the posttonic syllable of the first prosodic word of the sentence and an HL* is always associated with the ϕ that precedes the relative clause. Although is some cases the relative clause and the constituent that contains its antecedent appear to form a single I-phrase (see the illustration in (35)), in most of the cases there is doubt as to the type of break that separates the two syntactic constituents: a boundary L% tone may be identified but not very clearly, the constituent that contains the relative clause may show an initial H-tone—which is a characteristic of intonational phrase initial positions—the break between the relative clause and the constituent that contains its antecedent seems perceptually more important than regular ϕ breaks, and the relative clause may be uttered in a very low register (lower that the adjacent material) (see the illustration in (36), where some of the features just described occur).

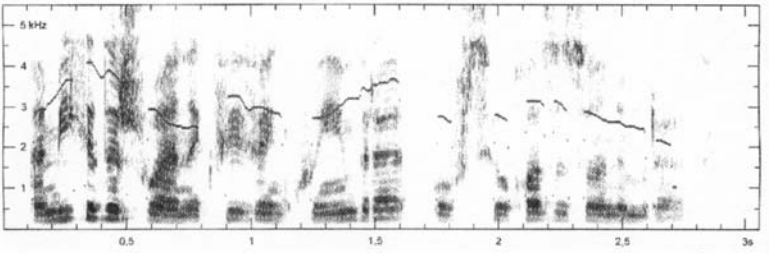
(35)



A amIga da JoAna que vIve em CoImbra // oferecEu rOsas ao namorAdo

| | | |
H HL* HL* L% ... ...

(36)



The preceding tonal description suggests that both the relative clause and what precedes it may form independent Is that are grouped together under a compound I domain, as shown in (37).

(37) ((A amIga da JoAna)$_{I}$ (que vIve em CoImbra)$_{I}$)$_{I}^{max}$ (oferecEu rOsas ao namorAdo)$_{I}$

In fact, such an analysis accounts for the fact that the word that precedes the relative clause is always pitch accented, since, given that units that are not the heads of I are often not assigned a pitch accent in EP, we have to explain why pitch accents in this position seem obligatory. It further explains the uncertainty as to whether a boundary tone is present before the relative clause, as well as the perceived facts described above. It should be added furthermore that although in the preferred interpretation the relative clause is indeed interpreted as restrictive, we believe these sentences also allow for the non-restrictive reading.[16] This again may be captured by the compound I analysis since it presupposes that the relative clause forms an independent (minimal) intonational phrase, as required for non-restrictive relative clauses.

The algorithms for the construction of prosodic structure presented at the beginning of this paper predict that a distinction between restrictive and non-restrictive clauses is prosodically cued. If it is assumed that non-restrictive clauses, like parentheticals, correspond to a string that is not structurally attached to the sentence tree, they must form independent intonational phrase domains. By contrast and regardless of the specific syntactic analysis adopted, restrictive clauses can be assumed to be structurally attached to the sentence tree and thus do not necessarily form independent intonational phrases.[17] Therefore, one possible prosodic phrasing for each type of relatives is given in (38).

16. This matter should be tested in future work. Here, we must rely on our own judgments of these realizations.
17. For example, Alexandre (2001), proposes that restrictive clauses are basically adjoined to the NP that contains their *antecedent*, while Fodor (2002) assumes that they are adjoined to N' positions.

(38) a. ((A amIga)$_{\phi}$ (da JoAna)$_{\phi}$)$_{I}$ ((que vIve)$_{\phi}$ (em CoImbra)$_{\phi}$)$_{I}$ *Non-restrictive*
((oferecEu rOsas)$_{\phi}$ (ao namorAdo)$_{\phi}$)$_{I}$

b. ((A amIga)$_{\phi}$ (da JoAna)$_{\phi}$ (que vIve)$_{\phi}$ (em CoImbra)$_{\phi}$ *Restrictive*
(oferecEu rOsas)$_{\phi}$ (ao namorAdo)$_{\phi}$)$_{I}$

As we have seen, the phrasing in (38a) always obtains in our data. By contrast, the phrasing in (38b) never does, because an intonational break necessarily follows the relative clause. This is easily explained by the fact that the I in (38b) is a very long constituent. Thus, the introduction of an I boundary between the relative clause and the following syntactic material is expected given that this is a major syntactic break (see (39)).

(39) ((A amIga)$_{\phi}$ (da JoAna)$_{\phi}$ (que vIve)$_{\phi}$ (em CoImbra)$_{\phi}$)$_{I}$
((oferecEu rOsas)$_{\phi}$ (ao namorAdo)$_{\phi}$)$_{I}$

However, the resulting phrasing yields unbalanced Is and the rightmost intonational phrase is not the longest one. The conditions are therefore met for introducing another partition, as in (40), where each I contains two ϕs.

(40) ((A amIga)$_{\phi}$ (da JoAna)$_{\phi}$)$_{I}$ ((que vIve)$_{\phi}$ (em CoImbra)$_{\phi}$)$_{I}$
((oferecEu rOsas)$_{\phi}$ (ao namorAdo)$_{\phi}$)$_{I}$

Nonetheless, this phrasing creates ambiguity. So, by grouping the I containing the antecedent and the one including the relative clause within a compound I domain, as in (41), helps resolving the ambiguity, since the restrictive reading is (at least) favored in this case.

(41) (((A amIga)$_{\phi}$ (da JoAna)$_{\phi}$)$_{I}$ ((que vIve)$_{\phi}$ (em CoImbra)$_{\phi}$))$_{I}^{max}$
((oferecEu rOsas)$_{\phi}$ (ao namorAdo)$_{\phi}$)$_{I}$

That compound I domains may be involved in sentence disambiguation was previously proposed by Ladd (1992, 1996). For example, a sentence like (42) may either be realized so that [his faithful black labrador] is interpreted as one of the entities Dubois lives with, in which case it constitutes an intonational phrase of the same type as adjacent intonational phrases, or it may be realized so that it is interpreted as the same entity as Jean-Charles, in which case there is a stronger prosodic connection between this intonational phrase and the preceding one. The latter phrasing may be obtained through intonational phrase compounding.

(42) Dubois lives in a restored 15th century farmhouse with Jean-Charles, his faithful black Labrador, and a motley assortment of cats.

Like before, the analysis resorting to compound intonational phrasing not only correlates nicely with the interpretation facts but most importantly it explains why some doubts have taken place regarding the level of prosodic break between the relative clause and its antecedent, as compound internal Is are prosodically less marked than non-internal ones.

The contrast observed between restrictive and non-restrictive clauses and the prosodic means used to disambiguate between the two are very similar to those described by Frota (2000: chap.2) for sentence and subject modifiers, respectively. An illustrative example is given in (43). In a sentence like (43a), the constituent *[até ao nono ano]* belongs to the same I as the preceding phrase and is separated from the following material by an I boundary and a pause. Here it is interpreted as a modifier of the subject. In a sentence like (43b), the same constituent forms an independent I phrase, separated by a pause at both edges. In this case, it is interpreted as a modifier of the sentence.

(43) a. As alunas até ao nono ano organizaram uma manifestação
'The students (from all grades) up to the 9th grade have organized a demonstration'

b. As alunas, até ao nono ano, organizaram uma manifestação
'The students, until the 9th grade have organized a demonstration'
(By contrast, after the 9th grade, they have organized two per year)

However, Frota does not report the possibility of introducing an I boundary between the subject and its modifier, unlike what we have seen to happen with our restrictive clauses. Additionally, she notes that the I that contains the subject and the one that contains the sentence modifier may be grouped under a compound I-domain, unlike in our non-restrictive clause cases. We believe that these differences are not due to the type of syntactic construction under investigation. Instead, they may be driven by distinct lengths of prosodic constituents in Frota's study and our own. In Frota's examples the modified subject consists of a single ϕ (*as* alunas) and the following modifier contains one ϕ as well (*até ao nono ano*). Therefore the conditions to form two different Is are not met and a single I containing two ϕs surfaces.[18] In our cases, by contrast, the antecedent of the restrictive relative clause forms two ϕs (*a amiga da Joana*) and the relative clause forms two ϕs as well (*que vive em Coimbra*). Besides this, the antecedent of the relative clause is not adjacent to it (it must be *a amiga* and not *(d)a Joana*). Thus, assuming that I-breaks may signal non-local attachment (see section 3 above, and the discussion in 4.2 and 5 below), the conditions seem to obtain for creating two Is. Thus, in this case the resulting compound I seems to be driven by the need of signaling the syntactic coherence between the relative clause and its antecedent. As to the cases in Frota (2000) where the subject and the sentence modifier are grouped under a compound

18. Besides this, the relation between heads and adjacent modifiers (like complements) should not be broken by an I-boundary (see section 5).

I-domain, they originate because the two obligatory Is that are created by the syntax-prosody mapping rules each contain a single ϕ, that is, the mapping algorithms give rise to two very small Is. Therefore, here compounding applies driven by weight requirements on the I-domain. By contrast, in our examples, both the I that contains the non-restrictive clause and the preceding one contain two ϕs, and thus I-compounding is triggered neither by prosodic nor by syntactic/semantic requirements and so it is not generated.

5.2. Local versus non-local relative clause attachment

One group of our relative clauses is also ambiguous as to the height of the constituent it modifies in the syntactic tree. This occurs only with non-restrictive clauses, whose antecedent may be *a amiga* or *(d)a Joana*. The discussion that follows focuses on the (im)possibility of prosodically disambiguating this sort of sentences.

We have seen above that when a syntactic constituent has two competing hosts, the presence of I-breaks intervening between that constituent and the preceding material may signal higher (non-local) attachment—we have seen it for PP adjuncts and complements in EP, and in English, Italian and Spanish (Avesani et al. 1995). And the same is also reported in Fodor (2002) for local and non-local attachment ambiguities involving restrictive relative clauses in an important number of languages (although here other factors may also be involved, like language-particular tendencies for inserting prosodic breaks before clauses, which are driven by the algorithms that relate syntax and phonology).[19]

As said above, in our sentences only non-restrictive relative clauses may be ambiguous with respect to their antecedent, since in general restrictive clauses do not take as a potential antecedent a proper noun. So, the question we are faced with is the following: as a prosodic break is obligatory before a non-restrictive clause, is its attachment necessarily ambiguous? Interestingly, it seems not. According to our intuition and of four other subjects to whom we asked for interpretation judgments, there is a very strong tendency for interpreting the antecedent of the non-restrictive relative clause as the non-adjacent constituent *a amiga*, rather than the adjacent one *(d)a Joana*. In other words, although the prosodic break is independently triggered by the syntax-prosody algorithms it seems to be reused for resolving the attachment ambiguity.

These findings are remarkably similar to those reported in Fodor (2002) that concern restrictive relative clauses ambiguous as to the height of their antecedent. On the basis of other studies cited therein, she observes that speakers show preference for lower attachment in languages like English or Swedish and for higher attachment in languages like French and Croatian. In order to explain this difference, she proposes that languages where non-local attachment is preferred are those whose interface constraints for prosodic phrasing favor a prosodic break before a relative

19. An interesting question not addressed in Fodor (2002) is whether the contrast between non-restrictive and restrictive clauses is preserved in languages like French, which apparently tend to insert an I boundary before clauses, and hence before relative clauses, unlike for instance English.

clause. So, here, such a break is also seen to be misconstrued as signaling the structural non-local relation between the relative clause and its antecedent. According to Fodor, although prosodic breaks may have other sources in languages, speakers will tend to use them as cues to solve ambiguity where such prosodic markings occur. Whenever there is ambiguity as to the source of prosodic marking, speakers will show a preference for configurational interpretations, that is, interpretations where syntactic constituency is congruent to that particular prosodic marking.

Going back to our data, we should point out that the results reported above cannot be attributed to the fact that the relative clause is locally preceded by a proper noun. In order to discard this possibility, we have presented to four other subjects sentences like the one in (44), where the lower syntactic constituent that could function as an antecedent is not a proper name. We have produced them in a way similar to the one described above, with the intonational phrase break before the relative clause that is typical of non-restrictive relative clauses. Invariably, these sentences were interpreted by our subjects precisely in the same way as when a proper noun immediately precedes the relative clause: non-local attachment is clearly the preferred reading and for some speakers this is even felt as the only possible interpretation.

(44) (A amiga da aluna)$_{I}$ (que vive em Coimbra)$_{I}$ (veio a Braga na semana passada)$_{I}$
'The friend of the student, who lives in Coimbra, came to Braga last weak'

Given the sound judgments we obtained, all pointing to an interpretation implying higher attachment, it could be thought that local attachment of non-restrictive clauses becomes unavailable under such a prosodic marking. This is not the case, however. That a local antecedent for non-restrictive clauses with similar syntactic structures is possible becomes very clear in sentences where the higher constituent may no longer be interpreted as a potential antecedent for the relative clause due to semantic features mismatches. This is illustrated in the sentence in (45), where, in addition, the local antecedent is a proper noun.

(45) (O carro da Joana)$_{I}$ (que vive em Coimbra)$_{I}$ (foi essencial para ela poder trabalhar em Portimão)$_{I}$
'The car of Joana, who lives in Coimbra, was crucial for her to be able to work in Portimão'

As in these cases the only constituent that may function semantically as the antecedent of the relative clause is the proper noun that immediately precedes it, it becomes clear that a local antecedent for non-restrictive relative clauses is possible. Importantly, here, as no other constituent is semantically appropriate to function as the antecedent of the relative clause, the prosodic break before the relative clause may no longer be interpreted as cuing higher attachment.

6. Conclusions and further issues

We have seen that prosody may disambiguate potentially ambiguous sentences that have distinct syntactic structures. In our study, two classes of such cases were observed. In one class, linear ambiguity is always prosodically disambiguated, while in the other disambiguation is not mandatory.

We have shown that prosodic structure always signals the direction of attachment of adverbs when they may either modify the constituent to their right or to their left. In order to account for the asymmetrical behavior of adverbs preceding and following the constituent they modify, we have proposed that adverbs only count as lexical heads when they are to the right of the element they modify, but not to their left. In this way, prosodic phrasing may reflect the basic syntactic distinction that correlates with different meanings. We have further noticed that like in other languages, in EP too the contrast between restrictive and non-restrictive clauses is in general prosodically cued. We have assumed that this distinction results from the fact that, contrary to restrictive relative clauses, non-restrictive relative clauses obligatorily form an independent intonational phrase domain, which in turn follows from the algorithms of I-domain construction.

In other cases, however, prosodic phrasing was shown not to necessarily cue distinct syntactic structures. This happens with PP attachment ambiguities, whether the PP functions as an adjunct or as a complement, and with relative clause antecedent ambiguities. It is known that a basic distinction between syntactic and prosodic structure is that the former has unlimited depth whereas the latter is flatter and has limited depth. This is a consequence of the kind of information used in the construction of prosodic constituents, the fixed number of prosodic domains and the principles embodied by the Strict Layer Hypothesis which govern the architecture of prosodic trees (see in particular Selkirk 1984, Nespor and Vogel 1986). Thus, given the nature of the relation between syntactic and prosodic structures, it is not surprising that the syntactic information related to the depth of embedding is not carried over to prosodic trees. Despite this, however, we have found that prosodic phrasing may indeed play a role in distinguishing sentences ambiguous as to the local/non-local attachment of a given constituent. Here, optional intonational phrase breaks are always crucially involved. We have seen that the insertion of an intonational phrase break to the left of a given constituent with more than one potential syntactic host preceding it always favors an interpretation whereby the constituent's host is not adjacent to it. Similar results are also reported in Fodor (2002) for restrictive clauses ambiguous as to their antecedent in various languages and similar cases of attachment ambiguity resolution with prepositional phrases are also found in languages like English, Italian and Spanish (cf. Avesani, Hirschberg and Prieto 1995). Optional intonational phrase insertion was thus seen to be interpreted as signaling higher syntactic attachment of constituents whose syntactic host is ambiguous.

Two major conclusions thus follow from our study. First, under the analysis proposed here, prosodic disambiguation necessarily obtains only when the aspects of the syntactic structure that are responsible for the different interpretations are

part of the syntactic information that is taken into account in the construction of prosodic structure, in which case the syntactic distinction is reflected in the prosodic phrasing. Second, optional intonational phrasing may signal, to a certain extent, syntactic embedding.

In order to understand why optional I-phrasing may signal syntactic embedding, we have to know when I-breaks may be inserted and when they may not. For space limitations we cannot develop enough this line of reasoning here. We may point out nevertheless that, not only in our data but also in all the descriptions we know of EP, it seems that optional I-phrases may not break up a sequence of adjacent head-complement or head-modifier in this language. We state the generalization that accounts for the facts as in (46).[20]

(46) Adjacent sequences of head-complement or modifier must belong to the same I.
(if something intervenes between them, however this restriction no longer applies)

The consequence of this generalization is that, if an I boundary intervenes between a head and a potential complement or modifier which is ambiguous as to its syntactic host, a non-local interpretation necessarily obtains, because it is part of speakers knowledge that under a local interpretation such I-break insertion is not allowed.[21]

Before we close, we would like to point out that there are other syntactic structures in EP that have been reported to constrain prosodic phrasing in a way not predicted by current algorithms for the construction of prosodic structure. Frota (1991, 1993) observes that sentences containing adverbs in syntactic positions where they can modify different constituents are often disambiguated by means of prosody. For example, an adverb like *gentilmente* ('kindly') may occupy several positions in a sentence like (47), which we indicate with a dash.

20. Selkirk (2000) proposes the constraint Align_{R} for English, which allows for the insertion of a prosodic break (a Major accentual phrase—MaP) before a major phrase boundary (see i). Assuming that this constraint interacts with Truckenbrodt's (1995) Wrap XP constraint, which prohibits the splitting up of a syntactic phrase, it is predicted that I-insertion through Align_{R} is optional. This constraint thus seems to capture our generalization for EP as well.

    (i) (She lóaned her róllerblades)$_{\text{MaP}}$ (to Róbin)$_{\text{MaP}}$

21. It should be noticed that the constraint in (46), which seems active in EP and in English (see the preceding footnote) is violable in other languages. For instance, according to Prieto (1997) it is possible to introduce an intonational boundary between the verb and its adjacent complement in a sentence like (i), with the interpretation given in the translation. And this is so regardless of the fact that the sentence is ambiguous with respect to the structural position of *llança* (on this particular case, see (4) in the introduction section above).

    (i) La vella llança l'amenaça
    'The old lady threatens him/her'

    The example in (i) also shows that the possibility of introducing an intonational boundary between the verb and the adjacent complement in Catalan is not triggered by length requirements on I-phrases.

(47) - Os rapazes - ofereceram - rosas às raparigas -
'The boys have offered roses to the girls'

In the two last positions, the adverb may form or not what we may interpret on the basis of Frota's description as an independent intonational phrase. The presence of such a prosodic phrasing has consequences for sentence interpretation. If the adverb constitutes an independent I, the sentence is ambiguous, since the adverb may be interpreted as a modifier of the verb (see the paraphrase in (48a)) or of the subject (see the paraphrase in (48b)). Nevertheless, although both interpretations are available, according to Frota this prosodic phrasing leads to a clear preference for the subject reading. Thus, the presence of an I-break between the adverb and the adjacent material inside the VP tends to be used as a cue for a non-local reading in these cases too. By contrast, if the adverb belongs to the same intonational phrase as the verb, only the interpretation whereby the adverb modifies the verb (or the VP) becomes available. In other words, the absence of the I-break necessarily implies the interpretation whereby the adverb is adjacent to the modified constituent.

(48) a. The boys gave flowers to the girls in a kind way
b. The boys were kind and gave roses to the girls

In addition, Frota shows that whenever an adverb occupies a superficial position distinct from the position where it is base-generated, or in other words, when it is outside its domain of modification, it is necessarily prosodically marked. This is illustrated by sentences like the one in (49), where the adverb may be interpreted as a modifier of the verb, but unlike when it is adjacent to V or the VP, it necessarily forms an independent I.[22]

(49) $[\text{Gentilmente}]_I$ $[\text{os rapazes ofereceram rosas às raparigas}]_I$

Since the I-phrasing is obligatory and independently obtained, in this case it cannot help in disambiguation.

To sum up, the presence/absence of an I-break seems to signal non-local/local readings that correlate with the syntactic position occupied by the adverb relative to its domain of modification.

The precise connection between these facts of prosodic phrasing that are syntax-related and those studied in our paper having to do with attachment ambiguities will have to be left for future research.

By now it has become uncontroversial that prosodic structure is not isomorphic to syntactic structure and much information on syntactic configuration is lost in the mapping between syntax and prosody. However, we believe to have shown

22. Here, the sentence is ambiguous since when the adverb is speaker-oriented or subject-oriented it is necessarily marked as well (see Frota 1993 for a possible explanation of these facts).

that the way prosodic phrasing relates to structural syntactic information may be more complex than what has been assumed in most current work on prosodic phonology. More investigation is thus required before we may form a clearer idea about the extent to which prosody may provide information on syntactic structures and the precise make up of the syntax-phonology interface.

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