Chapter 18

Syntax and prosody mapping: What and how?

The case of intonational periods and illocutionary units

Sylvain Kahane and Anne Lacheret-Dujour

Abstract

This chapter is devoted to the intonosyntactic interface, by exploring relationships between major prosodic and macrosyntactic units. It presents different kinds of mapping between intonational periods and illocutionary units, and discusses three basic constructions: alignment, when prosodic and macrosyntactic boundaries coincide; inclusion, when an intonational period groups several illocutionary units; and fragmentation, when an illocutionary unit is segmented by several intonational periods. We also exhibit a singular case of matching, called desynchronization, when neither prosodic boundaries nor macrosyntactic boundaries coincide with each other. These

different patterns are discussed in the light of functional and discourse constraints.

1. Introduction

The intonosyntactic interface has been extensively studied in theoretical linguistics and automatic speech processing, in particular in text-to-speech synthesis research. Regardless of the approach chosen (formal generativist paradigm *vs.* functional framework),[1] all analysts agree that there is a link between the syntactic and prosodic segmentation of the speech flow, but that this link is only partial (for reviews on French intonosyntax, see Lacheret-Dujour and Beaugendre 1999; Martin 2009). Therefore, for speech production, the issue is: To what extent does syntax pilot the segmentation into prosodic units? And for speech comprehension: How and to what extent do prosodic constructions guide the syntactic parsing of a text?

Three kinds of units are considered in this chapter: the *intonational period* (IPE), the *intonation package* (IPA) and the *illocutionary unit* (IU). Intonational periods (IPEs) are the largest prosodic units. The IPE boundaries (IPEBs) are based on a set of three phonetic parameters (pause,

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[1] For a presentation of both frameworks, see Part 2, Chapter 8.

intonational contour before the pause, and resetting after the pause, Chapter 10). Bullets (•) represent boundaries of intonation packages (intonational groups) in Rhapsodie. When they are not IPEBs, intonation package boundaries always follow a syllable with a strong prominence (Chapters 9 and 11). Illocutionary units (IUs) are the largest macrosyntactic units, that is, units grouping non-autonomous microsyntactic components around a nucleus bearing illocutionary force (Chapter 6). Prosodic and macrosyntactic boundaries were defined independently and annotated by two different teams in the Rhapsodie project. Moreover, the IU boundaries (IUBs) are secondary notions derived from IUs, while prosodic boundaries are primary notions from which major prosodic units are derived. In other words, syntactic boundaries, unlike prosodic boundaries, are not marked and can only be deduced from the fact that words on the left and the right of a given point combine with different words and belong to different units.

The two following basic assumptions are widely shared by scholars (for a detailed presentation, see Mertens 1993; 1997). First, the feature ± clitic should be taken into account to begin the derivation of the prosodic structure: A prosodic group contains at least one non-clitic word. We call this the *Cohesion Principle*. In other words, some portions of the text, often called syntactic chunks (Abney 1991), are particularly cohesive and cannot be easily broken by prosodic boundaries. In terms of dependency syntax, this means that the two vertices of some dependencies tend not to be

3

separated by a prosodic boundary. This is the case for dependencies between preverbal clitics and their host verb (*il le lui donne,* 'he gives him it'), between a noun and its determiner (*une association,n* 'an association'), or between a preposition and the noun it governs; see Gendrot et al. (2016) for an application of this principle to the synthesis of prosody in French.

Second, while intonosyntactic rules cannot be easily expressed in terms of syntactic constituents (the two boundaries of a prosodic unit rarely correspond to the two boundaries of the same syntactic constituent), they can be expressed in terms of dependency syntax: The words of every prosodic unit tend to form a connected subpart for the syntactic dependency tree and therefore to be rooted by one of the words of the unit. We call this property the *Connectedness Principle*. It can be illustrated by example (1).

(1) *et vous appartenez • à ce qu'on appelle • les flying doctors • de la Mref • qui est une une association des médecins • et de de de recherche • qui est basée ici • à • à Nairobi • au Kenya IUB•IPEB* [Rhap-D2004, Lacheret corpus]

    'and you belong • to what we call • the flying doctors • from Mref • which is an an association of doctors • and of of of research • that is based here • in • in Nairobi • in Kenya IUB•IPEB'

Example (1) constitutes an intonational period (IPE) and an illocutionary unit (IU) segmented into eleven intonation packages. Only three of them (*de la Mref, et de de de recherche, au Kenya*) correspond to syntactic constituents. The remaining eight are only parts of constituents. For instance, the first intonation package *et vous appartenez,* 'and you belong', is the beginning of a clause that is, cut in the middle of its VP, the second

package *à ce qu'on appelle,* 'to what we call', is the beginning of a PP that stops in the middle of an embedded relative clause, and so on. Now if we look at the dependency structure of (1), given in Figure 1, we see that all the intonation packages, separated by vertical lines in the figure, are connected from the point of view of syntactic dependency. For instance, the dependency structure of *à ce qu'on appelle* is a connected subpart of the whole dependency tree, forming a dependency subtree, the root of which is *à*.
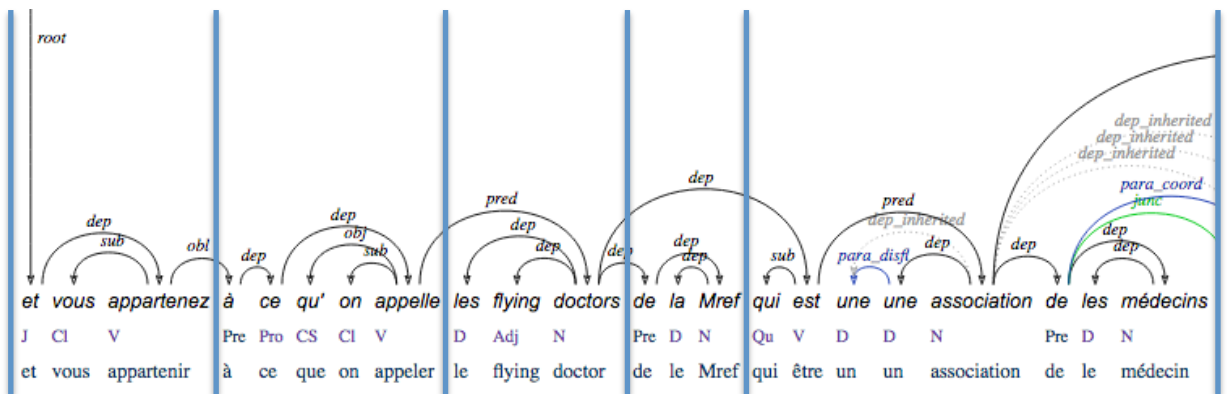

Figure 1. The dependency structure of (1) segmented into intonation packages (separated by vertical blue lines)

Example (2) further illustrates our principles.

(2) *eh oui IUB • euh • j'ai commencé • par euh • travailler comme médecin de campagne à un endroit qui s'appelait Olkaloo • IPEB juste au sud • de l'équateur IUB•IPEB* [Rhap-D2004, Lacheret corpus]

    'yes IUB • um • I started • to um • work as a country doctor in a place that was called Olkaloo • IPEB just south • of the equator IUB•IPEB'
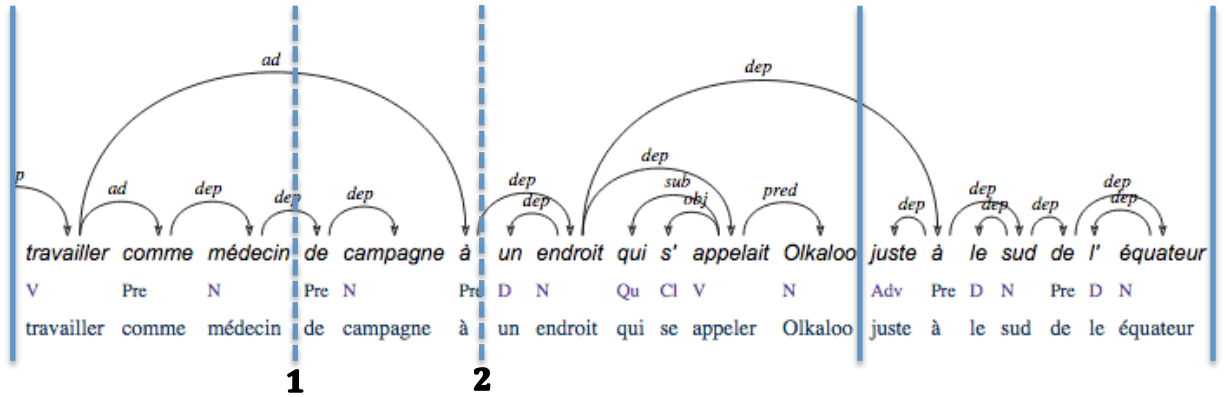
Figure 2. Two examples of problematic additional prosodic boundaries for (2)

Suppose that we want to add some prosodic breaks, represented in Figure 2 by dashed vertical lines. If the first break ('1') between *médecin,* 'doctor', and *de champagne,* 'from country', is added, it would violate the Connectedness Constraint because *de campagne* would be in the same prosodic unit as *à un endroit qui s'appelait Olkalo,o* 'in a place that was called Olkaloo', without forming a connected dependency structure with it. The second break ('2') after *à* would also be quite inappropriate due to the Cohesion Principle: There is a strong syntactic cohesion between the preposition and its complement and it would be much more appropriate to have a prosodic break before the preposition due to the distant link between the preposition and its governor.

It is important to recall that the two principles enunciated here, Connectedness and Cohesion, were not used for the prosodic annotation. The annotation was based only on perceptual indices without any reference

to the syntactic structure or even to morphosyntactic information concerning clitics, determiners or prepositions. Due to this methodology, in which syntactic and prosodic annotation were conducted separately, Rhapsodie treebank is an appropriate resource to verify whether the principles are applied in non-elicited speech. Consequently, we find some cases where these constraints are violated. The next example (3) violates the Cohesion Principle twice: An intonation package boundary can be observed between the clitic *se* and its verb host *faire* (*se faire à N*, lit. do oneself to N' means 'get used to N'), as well as between the noun *variations,* 'variations' and its determiner *ces* 'these'.

(3) *et • euh • il faut • il faut • apprendre à à s~ je dirais se se • faire à ces • variations IUB•IPEB* [Rhap-M2002, Rhapsodie]

'and • um • we have • we have • to learn to to g~ I'd say get get • used to • these variations IUB•IPEB'

In this chapter, we will concentrate on the maximal units of Rhapsodie's annotation. Delimitation and the interface between maximal syntactic units and maximal prosodic units have been much less studied than for their internal units in both functional and formal frameworks and thus remain open questions. In a preliminary study on one narration (a life story) of 30 minutes, Lacheret-Dujour and Victorri (2002) evidenced three basic configurations between intonational periods and government units (called *syntactic dependency clauses* in this paper): alignment (the right boundaries of both units occur at the same time), fragmentation (a clause is fragmented

into several intonational periods) and inclusion (several clauses are grouped in one intonational period). Degand and Simon (2009) extended this first study by conducting a careful investigation into four discourse genres (political address, radio news, conference talk and conversational narration, amounting to about 40 minutes of speech). They argued that four kinds of mapping between "dependency clauses" and "major prosodic units" can be identified: "congruent (one-to-one mapping), syntax-bound (one dependency clause cut into several major prosodic units), intonation-bound (one major prosodic unit enclosing several dependency clauses) and regulative (one discourse marker or adjunct with prosodic autonomy)." While the first three are identical to the configurations of alignment, fragmentation, and inclusion proposed by Lacheret-Dujour and Victorri (2002), the fourth emphasizes that macrosyntactic peripheral components tend to have prosodic autonomy. Degand and Simon (2009a) postulated that these different combinations depend mainly on the genre at stake. This work was extended in Martin et al. (2014) on a corpus of 42 samples of 3 to 5 minutes (which is comparable to Rhapsodie) distributed among 12 genres. The authors noted a fifth kind of mapping where prosodic and syntactic boundaries alternate without corresponding, but they focused on regulative units.

Following on from these analyses, the study presented in this chapter focuses on the maximal macrosyntactic and prosodic units of the Rhapsodie

annotation: *illocutionary units (IUs)* and *intonational periods (IPEs)*. We will address this issue by focusing on the synchronisation of the different types of boundaries, which punctuate these macrosyntactic and macroprosodic units. We will study the mapping of IU and IPE boundaries in Section 2. What happens between two synchronized boundaries is presented in detail in Section 3 where we study the distribution of alignment (called here *synchronization*), fragmentation, and inclusion and see that a fourth situation, which we call *desynchronization*, appears when IU and IPE boundaries alternate without synchronizing. We show that desynchronization remains less frequent than if boundaries had been distributed randomly.

2. General overview of IU and IPE boundaries

We start our study of the mapping between major macrosyntactic and prosodic boundaries by the computation of ratios between these two types of boundaries (Section 2.1). As these ratios do not provide any clues about the effective mapping of syntactic and prosodic boundaries, the proportion of IU and IPE boundaries mapping to each other was studied first globally

(Section 2.2), secondly per sample (Section 2.3) and finally by genre (Section 2.4).

2.1 IUB/IPEB ratio

The Rhapsodie treebank contains 2,849 intonational period boundaries (IPEBs) and 3,154 illocutionary boundaries (IUBs). This gives a general IUB/IPEB ratio of 1.10, which suggests that the corpus contains more inclusions than fragmentations, but does not give any information about synchronization.

The distribution of IPEBs and IUBs is not homogenous and varies widely from one sample to another. Some of our samples have an IUB/IPEB ratio almost equal to 5, that is, five boundaries of illocutionary units for one intonational period boundary, while others are exactly the opposite and have five boundaries of IPEs for one IU boundary, that is, an IPEB/IUB ratio of 5 (Figure 3).
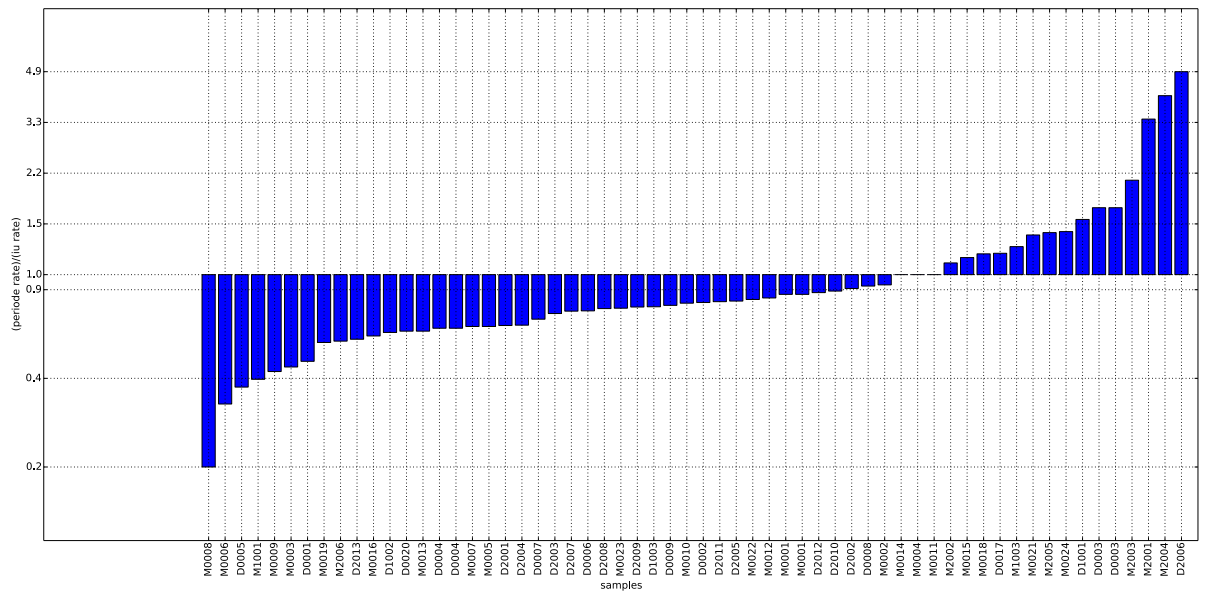
Figure 3. (from Beliao 2016) IPEB/IUB ratios per sample, ordered from the samples with more IUs than IPEs (on the left) to the samples with more IPEs than IUs*. A logarithmic scale was used to have the same bar length when IPEB/IUB = 5 and IPEB/IUB = 1/5.

* The ratio may be underestimated for dialogues, especially interactive dialogues with numerous overlaps, since at most one speaker is analyzed at the prosodic level in overlaps (Chapter 10)

A difference in the IUB/IPEB ratio between samples was expected, but not such a pronounced one: For a fixed number of IPEs, the proportion of IUs even varies from 1 to 25. For instance, [Rhap-D2006] has one IUB for five IPEBs, while [Rhap-M0008] has 25 IUBs for five IPEBs. In other words, it is impossible to predict the number of IUs given the number of IPEs without any information about the type of discourse and other factors that influence their frequency.

Our four samples of oratorical speech are clearly detached (the four bars on the right of Figure 3 and show a higher IPEB/IUB ratio than the other

11

discourse sequences. This is mainly due to the scansion phenomena that will be illustrated in Section 3.3. Other discourse sequences do not show a particular behavior of the IPEB/IUB ratio. We have seen that the IPEB/IUB ratio may vary considerably from one sample to another. We will now see that even for the same ratio, the mapping between IUBs and IPEBs may differ.

2.2 IUB-IPEB mapping

As said in Section 2.1, the fact that the numbers of intonational periods and illocutionary units are similar (2,849 IPEs for 3,154 IUs) does not imply that the boundaries of IPEs and IUs are synchronized in general. The treebank contains 1,742 synchronized boundaries, that is, boundaries common to IUs and IPEs.

Examples (4) and (5) show a non-synchronized IPEB followed by a non-synchronized IUB before a synchronized boundary (noted IUB•IPEB).

(4) tu continues la rue • IPEB la petite rue IUB • et tu arrives à la fontaine euh place Notre-Dame IUB•IPEB [Rhap-M0001, Avanzi]

    'you carry on down the street • IPEB the little street IUB • and you arrive at the fountain um Notre-Dame square IUB•IPEB'

(5) *alors il est nécessaire • maintenant • euh d'associer • le lecteur • IPEB à la jouissance d'écrire IUB • il n'y a pas • de jouissance d'écrire • sans jouissance de lire IUB•IPEB* [Rhap-D2009, Mertens]

 'then it is necessary • now • um to associate • the reader • IPEB in the pleasure of writing IUB • there is no pleasure of writing • without the pleasure of reading IUB•IPEB'

The Rhapsodie treebank contains 1,412 non-synchronized IUBs among the 3,154 IUBs, that is, 45% of IUBs are non-synchronized with an IPEB (Table1a) It contains 1,107 non-synchronized IPEBs among the 2,849 IPEBs, that is, 39% of IPEBs are non-synchronized with an IUB (Table1b) If both boundaries – IUBs and IPEBs – are considered, we have 4,261 boundaries and 59% of them are non-synchronized (Table 1c).

Table 1a. Frequency and ratio of synchronized IUBs

	number	%
synchronized IUBs (IUB•IPEB)	1742	55
non-synchronized IUBs	1412	45
total of IUBs	3154	100

Table 1b. Frequency and ratio of synchronized IPEBs

	number	%
synchronized IPEBs (IUB•IPEB)	1742	61
non-synchronized IPEBs	1107	39
total of IPEBs	2849	100

Table 1c. Frequencies and ratios of synchronized boundaries

	number	%
IUB•IPEBs	1742	41
non-synchronized IUBs	1412	33
non-synchronized IPEBs	1107	26
total of boundaries	4261	100

The main comment that can be made concerning these results is that more or less half of the boundaries synchronize: A majority of IUBs and IPEBs synchronizes (55% and 61%), but if we consider both together only a minority are synchronized (41%).

We hypothesize that boundaries tend to synchronize when it is possible, that is, that IPEBs tend to synchronize with IUBs when the speaker produces fewer IPEs than IUs; and conversely that IUBs tend to synchronize with IPEBs when the speaker produces fewer IUs than IPEs. Whether this is true will be investigated in Section 3.

2.3 IUB-IPEB mapping per sample

We know that 55% of IUBs and 61% of IPEBs synchronize across the whole corpus, but we also know that we have a great disparity in the

IPEB/IUB ratio among our samples. Let us see what happens for each sample. Figure 4 (from Beliao 2016) displays the percentage of synchronized IUBs (Table 1a) and synchronized IPEBs (Table 1b).
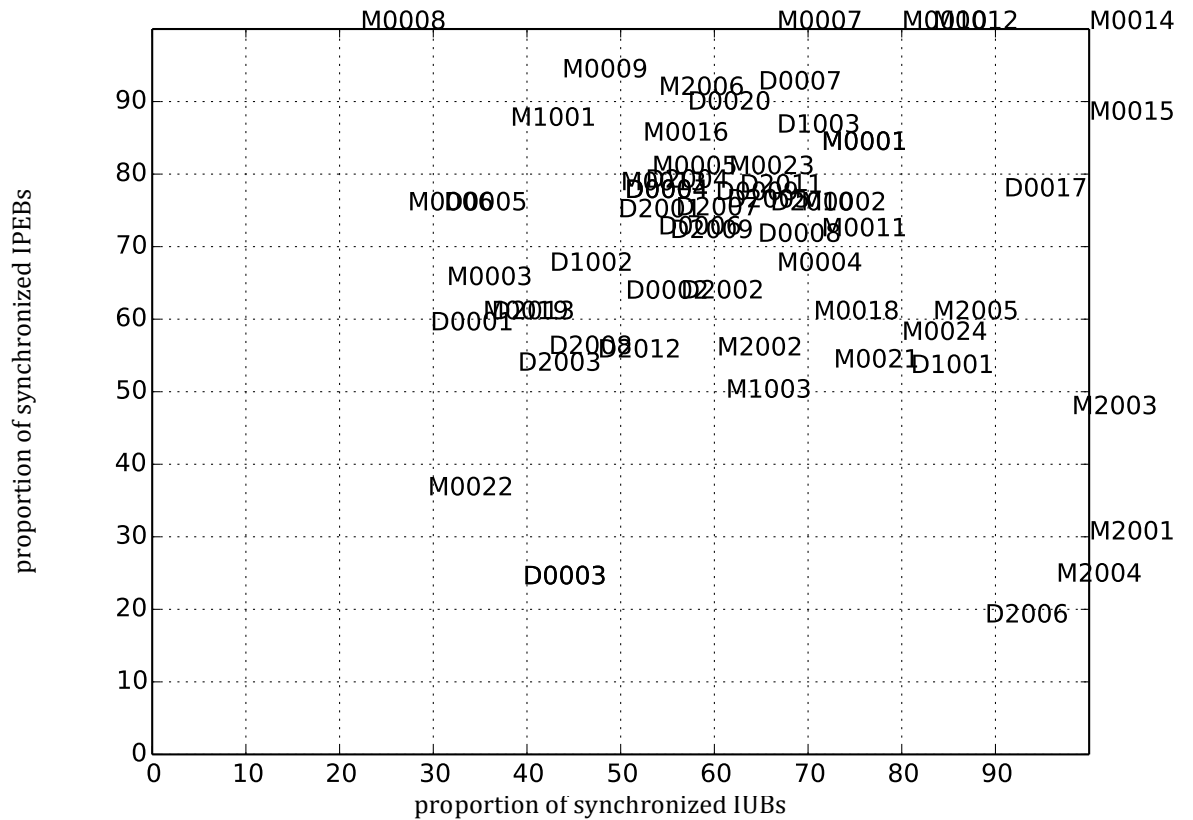

Figure 4. (from Beliao 2016) Proportion of synchronized IUBs and IPEBs per sample

The samples on the far right border in Figure 4 have 100% of their IUBs that map with an IPEB, while the samples on the top border have 100% of their IPEBs that map with an IUB. For instance, [Rhap-M2004], which is

near the bottom of the right border, has many more IPEBs than IUBs as in example 6.[2]

(6) *mes chers • compatriotes • IPEB je voudrais d'abord • IPEB exprimer ma sympathie • IPEB à toutes celles • et à tous ceux • qui vivent • ces derniers jours • de mille neuf cent quatre-vingt-dix • -neuf • dans l'épreuve IUB•IPEB* [Rhap-M2004, Rhapsodie]

    'my dear compatriots • IPEB I would like first • IPEB to express my sympathy • IPEB to all those • who live • these last days • of nineteen ninety • -nine • in hardship IUB•IPEB'

Conversely, [Rhap-M0008], which is towards the left on the top border, has many more IUBs than IPEBs and all its IPEBs are synchronized with an IUB as in example (7).

 (7) *vous allez à Hermillon IUB • et • euh • ensuite • vous prenez la direction de Saint-Jean IUB • vous passe~ euh vous prenez la • grande ligne droite IUB • et vous • tournez • à • à gauche IUB euh • vous passez devant les pompiers IUB • et ensuite • il y a une ligne droite IUB • vous allez à droite IUB•IPEB* [Rhap-M0008, Avanzi]

    'you go to Hermillon IUB • and • um • then • you take the direction of Saint-Jean IUB • you pass um you take the • big straight road IUB • and you • turn • to • to the left IUB um • you go past the fire station IUB • and then • there is a straight road IUB • you go to the right IUB•IPEB

At the intersection of the right and the top borders, in the top right corner, we find samples with only synchronized boundaries, such as [Rhap-M0014], as in example (8), described by the following discourse features:

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[2] The appellative *mes chers compatriotes* 'my dear compatriots' could have been considered as a separate IU rather than a prenucleus (Chapter 6). The only test we have here is to listen to this segment alone and to decide whether it forms a saturated utterance.

[+monologue, +private, +spontaneous, +face to face, -interactive, +procedural].

(8) *alors en partant • de la place • Paul Vallier • pour aller à la place Notre-Dame IUB•IPEB alors • j'emprunte la rue de Strasbourg IUB•IPEB je passe par la place Vaucanson IUB•IPEB je • prends • direction Maison du tourisme IUB•IPEB euh • à la Maison du tourisme • je • contourne enfin je prends • la rue de la République en remontant la rue de la République IUB•IPEB je tombe • sur la place • Sainte-Claire • on va dire • là où il y a la halle IUB•IPEB et j'arrive • à la place Notre-Dame IUB•IPEB* [Rhap-M0014, Avanzi]

'so leaving • square • Paul Vallier • to go to Notre-Dame square IUB•IPEB so • I take Strasbourg street IUB•IPEB I go through Vaucanson square IUB•IPEB I • take • the Tourist Office direction IUB•IPEB um • at the Tourist Office • I • walk round well I take • the street of the Republic walking up the street of the Republic IUB•IPEB I come out • onto Sainte-Clair • square • let's say • where there is the covered market IUB•IPEB and I arrive • at Notre-Dame square IUB•IPEB'

All the samples along the bottom left to top right diagonal in Figure 4 have an IPEB/IUB ratio of 1.[3] But only samples in the top right corner synchronize on all their boundaries. The farther the sample is from the top right corner, the less synchronized its boundaries are. An example is the extract from [Rhap-M0022] in example (9), which is the sample that is the closest to the bottom left corner. This extract shows non-synchronized

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[3] For these samples, the IUB•IPEB/IUB and IUB•IPEB/IPEB ratios are equal, which means that IPEB/IUB = 1.

boundaries one after another: four non-synchronized IUBs and two non-synchronized IPEBs for only one IUB•IPEB.[4]

(9) *sauf que pour le policier c'est quand même du vol IUB • donc • il embarque • euh • mh • le Chaplin • IPEB pour • ensuite • on se retrouve IUB • donc tout le monde s'en va y compris la foule • puisque la foule est intéressée par les • flics euh IUB • on se retrouve donc avec le boulanger • IPEB la jeune fille au • sol • et la vieille dame • qui revient vers le boulanger • pour lui dire non IUB ce n'est pas le monsieur IUB mais c'est la jeune fille effectivement IUB•IPEB* [Rhap-M0022, Rhapsodie]

    'except that for the policeman it's really a theft IUB • so • he arrests • um • hum • the Chaplin • IPEB for • then • we find ourselves back IUB • so everybody leaves including the crowd • since the crowd is interested in the • cops um IUB • we find ourselves back with the baker • IPEB the girl on • the floor • and the old lady • who goes back to the baker • to tell him no IUB it's not the man IUB but it's the girl indeed IUB•IPEB'

We can now look at the distribution of IUBs and IPEBs per discourse sequence.

2.4 IUB-IPEB mapping per discourse sequence

Figure 5 is produced by the Trameur tool and shows the specificity (Chapter 15) of the main boundaries that are studied: non-synchronized IUBs, non-synchronized IPEBs and synchronized boundaries (IUB•IPEBs). [5] As

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[4] The incomplete sequence *pour ensuite on se retrouve,* 'for then we find ourselves back', is not very easy to analyze. It would have been possible to consider an IUB after *pour* or *ensuite.*

[5] Our three kinds of boundaries can be easily extracted with Trameur: for instance, the last word of a non-synchronized IUB is L or U for IU and B or I for IPEB.

expected, non-synchronized IPEBs are very specific of oratory. But non-synchronized IUBs are also very specific of this discourse sequence, due to their under-representation. We can also observe a certain specificity (Chapter 15) of non-synchronized IUBs for argumentative speech and of synchronized boundaries (UIF•IPEBs) for procedural speech.
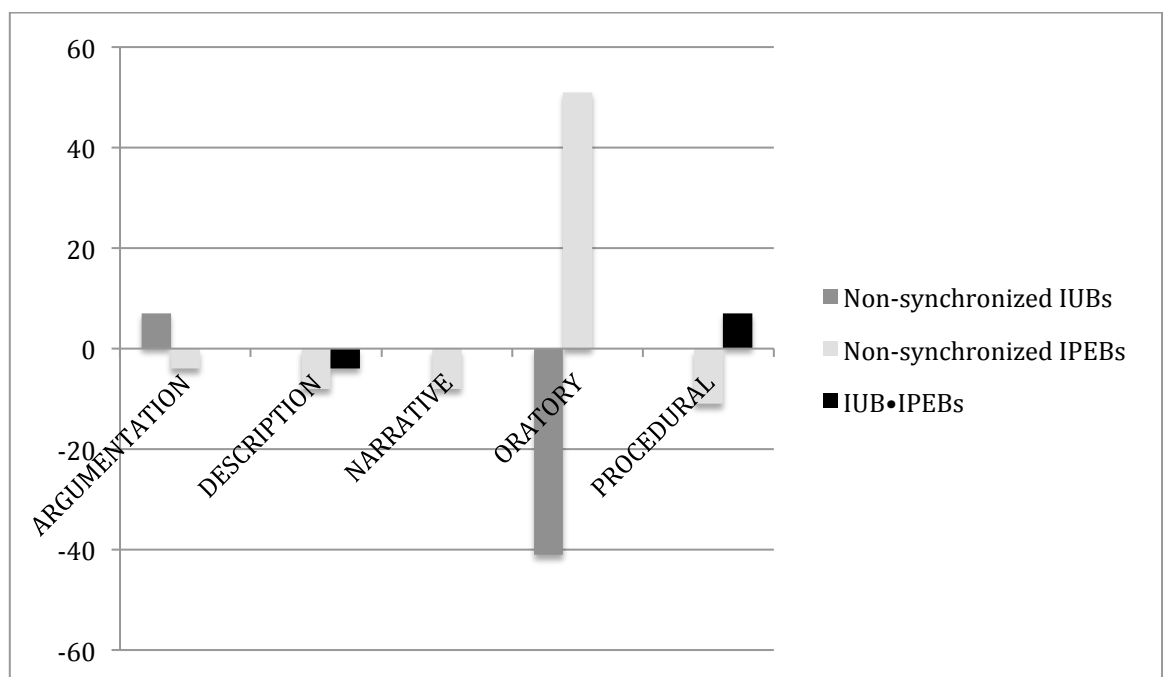

Figure 5. Specificity indices of the number of synchronized and non-synchronized boundaries for the variable *discourse sequence*

Nevertheless, the proportions of non-synchronized IUBs, non-synchronized IPEBs, and synchronized boundaries do not tell us precisely how these three kinds of boundaries are distributed. This is the topic of the next section.

3. Distribution of boundaries

The distribution of non-synchronized IUBs and non-synchronized IPEBs is not uniform. We are particularly interested in how non-synchronized IUBs and non-synchronized IPEBs are deployed dynamically in the flow of speech and to what extent they follow each other or not. We therefore looked at what happens between two successive synchronized boundaries (i.e., IUB•IPEBs) (Section 3.1). The various configurations observed are presented in the following sections: exact synchronization (Section 3.2), inclusion (Section 3.3), fragmentation (Section 3.4), and desynchronization (Section 3.5). For each configuration a typical sample will be analyzed. In the case of fragmentation and desynchronization, the (micro- and macro-) syntactic status of non-synchronized IPEBs will be studied.

3.1 Intonosyntactic units

To understand how non-synchronized illocutionary unit or intonational period boundaries are distributed, we introduce a new notion, the *intonosyntactic unit (ISU),* which is a segment of the text bounded by two

consecutive synchronized boundaries (IUB•IPEB). [6] We consider that synchronized boundaries are points where the speaker resets both the syntax and the prosody and that a sequence between two such points has a form of cohesion that justifies considering it as a possibly interesting linguistic unit. We observe three major kinds of intonosyntactic units:

The *synchronous ISU* is an ISU that does not contain an IUB or IPEB. In other words, the synchronous ISU is both an IU and an IPE. Example (10) shows two successive synchronous ISUs. This configuration is illustrated in Figure 6, where IUs are represented by white boxes and IPEs by black boxes.

(10) *après tu montes une grande • grande ligne droite IUB•IPEB tu passes • devant la piscine IUB•IPEB* [Rhap-M0009, Avanzi]

    'next you go up a long • long straight road IUB•IPEB you walk past the swimming pool IUB•IPEB'

IUB [   ] IUB
IPEB [████████████████████████████████████] IPEB

Figure 6. A synchronous ISU: One IU coincides with one IPE

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[6] Bear in mind that microsyntax can go beyond an IUB, producing what we call an *epexegesis* or *afterthought* (Chapter 6). Such an IUB is often synchronized with an IPEB and therefore two ISUs can be linked by a dependency relation (see examples in Section 3.4). In Pietrandrea et al. (2014), the maximal sequence characterized by the fact that its components are linked to one another by at least one of the three mechanisms of cohesion considered in Rhapsodie was called an *Extended discourse unit (EDU)*: microsyntax, macrosyntax, and prosody. An EDU is generally an ISU, but can be the union of two ISUs in the case of epexegesis.

The *inclusive ISU* is an ISU that contains IU boundaries but no IPE boundaries (Figure 7). In other words, an inclusive ISU is an IPE that includes several IUs, as in example (11). It is a kind of paragraph.

(11) *euh • il y a un • stade aussi • à côté IUB • et tu arrives à un rond-point IUB • donc là tu rentres dans le centre-ville IUB•IPEB* [Rhap-M0009, Avanzi]

'um • there is a • stadium too • nearby IUB • and you arrive at a roundabout IUB • so there you enter the city center IUB•IPEB'

Figure 7. An inclusive ISU: One IPE contains three IUs

The *fragmented ISU* is an ISU that contains IPE boundaries but no IU boundaries (Figure 8). In other words, the fragmented ISU is an IU that is fragmented into several IPEs as in example (12).

(12) *je pense • aux nombreuses victimes • de la tempête • IPEB et à • toutes les familles • IPEB endeuillées • IPEB dont nous partageons la peine IUB•IPEB* [Rhap-M2004, Rhapsodie]

'My thoughts are • with the numerous casualties • of the storm • IPEB and with • all the families • IPEB in mourning • IPEB whose sorrow we share IUB•IPEB'

Figure 8. A fragmented ISU: One IU contains four IPEs

There is a fourth kind of ISU, the *asynchronous ISU* which is an ISU that is both inclusive and fragmented (Figure 9), in other words that contains both non-synchronized IU and only IPE boundaries as in example (13).

(13) *mais à cette époque • IPEB on vous remarquerait IUB • et d'ailleurs • quelqu'un vous a remarquée • qui est dans une grande • limousine noire IUB•IPEB* [Rhap-2010, Rhapsodie]

‘but at that time • IPEB you would be noticed IUB • and besides • someone noticed you • who is in a big • black limousine IUB•IPEB’

Figure 9. An asynchronous ISU: An IU and an IPE overlap without synchronizing

In an asynchronous ISU, an IU and an IPE overlap each other. In (13), the IU *mais à cette époque on vous remarquerait,* ‘but at that time you would be noticed’, overlaps with the IPE *on vous remarquerait et d'ailleurs quelqu'un vous a remarquée qui est dans une grande limousine noire,* ‘you would be noticed and besides someone noticed you who is in a big black limousine’. Note that this IPE does not verify the Connectedness Constraint since there is no syntactic dependency between the end of the first IU *on vous remarquerait* and the next IU *et d'ailleurs quelqu'un vous a remarquée qui est dans une grande limousine noire.*

3.2 Distribution of ISUs

The distribution of our different kinds of ISUs is given in Table 2a. Our study was done on a genre-balanced subpart of the Rhapsodie treebank

containing 388 ISUs. The rows indicate the number of non-synchronized IUBs inside the ISU, and the columns, the number of non-synchronized IPEBs inside the ISU. In other words, ISUs in the first row contain no IUBs and ISUs in the first column contain no IPEBs. Therefore an ISU in the top left box has neither an IUB nor an IPEB, and is a synchronous ISU. The other ISUs in the first row are fragmented: They contain no IUBs, only IPEBs (33 IUs contain one IPEB and 47 contain at least two IPEBs). Similarly the other ISUs in the first column are inclusive, containing no IPEBs, only IUBs. The boxes which are neither in the first row nor in the first column contain ISUs with both IUBs and IPEBs, that is, asynchronous ISUs (for instance, 16 ISUs contain one IPEB and at least two IUBs); see Table 2b.

It can be seen that 42% of ISUs are synchronous, which is an appreciable amount, but that more than half of ISUs are not synchronous. The distribution between fragmented and inclusive is comparable (i.e., 21% vs. 25%).[7] The number of asynchronous ISUs is significant, accounting for 12%. All these frequencies are discussed in the following subsections.

Table 2a. Distribution of a selection of 388 ISUs according to their internal boundaries

IUB \ IPEB	0	1	2+

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[7] We observe a ratio of 164/388 = 42% of synchronous ISUs, (33+47)/388 = 21% of fragmented ISUs, (53+44)/388 = 24% of inclusive ISUs, and (10+11+16+10)/388 = 12% of asynchronous ISUs.

0	164	33	47
1	53	10	11
2+	44	16	10

Table 2b. The four types of ISUs

IUB \ IPEB	**0**	**1**	**2+**
0	synchronous	fragmented	
1	inclusive	asynchronous	
2+			

Table 2c. Distribution of ISUs among the four types (percentage)

IUB \ IPEB	**0**	**1**	**2+**
0	42%	21%	
1	25%	12%	
2+			

Synchronous ISUs are relatively common, accounting for 42% in the subpart of the treebank studied.[8] There is even one of our samples in which all the ISUs are synchronous (Rhap-M0014, presented in full in Section 2.3, supra).

Let us recall that 41% of our boundaries are synchronized boundaries (IUB•IPEBs; Table 1c). If the three kinds of boundaries (IUB, IPEB, and

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[8] Simon (2015) obtained a very similar result (43%) on the Louvain Corpus of Annotated Speech.

IUB•IPEB) were distributed uniformly, the probability that the boundary after an IUB•IPEB is another IUB•IPEB would be 41% and consequently we would have 41% of synchronous ISUs, which is very close to what is observed (Table 3). Similarly, 24% of ISUs with only one internal boundary were expected with a uniform distribution and 35% with two or more internal boundaries, which is also almost what is observed.[9] As Table 2a shows, we have 22% of ISUs with exactly one internal boundary and 36% of ISUs with two or more internal boundaries.[10] Nevertheless, the distribution of non-synchronized IUBs and non-synchronized IPEBs is not so uniform, as we will see now.

Table 3. Predicted and observed distributions of ISUs

	Prediction	Observation
synchronous ISUs (= ISUs without internal boundary)	41%	42%
ISUs with exactly one internal boundary	24%	22%
ISUs with two or more internal boundaries	35%	36%
inclusive ISUs (= ISUs with only IUBs)	20%	25%
fragmented ISUs (= ISUs with only IPEBs)	14%	21%

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[9] With a uniform distribution, the probability of having only one internal boundary is $0.59 \times 0.41 = 0.24$, because the likelihood that the first boundary is not IUB•IPEB is 59% and that the second boundary is IUB•IPEB is 41%. The probability of having at least two internal boundaries is $0.59 \times 0.59 = 0.35$.

[10] $(33+53)/388 = 0.22$ and $(47+44+10+11+16+10)/388 = 0.36$.

asynchronous ISUs (= ISUs with both IUBs and IPEBs)	25 %	12%

3.3 Inclusive ISUs

Inclusive ISUs are ISUs grouping several IUs in one IPE. Such ISUs appear when the speaker produces more IUBs than IPEBs and IPEBs are synchronized with IUBs. We found 25% of inclusive ISUs, which is a more than the 20% expected with a uniform distribution.[11] Table 4 shows the profile of [Rhaps-M1001], an interview of a student relating her career, with synchronous and inclusive ISUs, but no fragmented ISUs.

Table 4. Profile of [Rhaps-M1001, Rhapsodie], a sample with a high proportion of inclusive ISUs.

IUB \ IPEB	0	1	2+
0	3	0	0
1	3	0	0
2+	5	2	0

---

[11] The proportion of non-synchronized IUBs is $p = 0.33$ (Table 1c). We expect $p \times 0.41$ inclusive ISUs with one internal non-synchronized IUB (cf. Note 7), $p^2 \times 0.41$ with two internal non-synchronized IUBs, etc. Therefore we expect $(p + p^2 + p^3 + ...) \times 0.41$ inclusive ISUs. As $(1-p)(p + p^2 + p^3 + ...) = p$, we finally expect $p/(1-p) \times 0.41 = 0.20$ inclusive ISUs.

The beginning of [Rhaps-M1001] illustrates descriptive sequences where successions of facts are grouped in the same paragraph realized by a unique IPE, as in example (14).

(14) *alors euh je m'appelle Clara IUB • j'ai dix-neuf ans IUB • j'ai eu • l'obtention de mon • bac euh donc l'année dernière IUB•IPEB c'est un • bac euh SMS • donc technologique IUB•IPEB c'est sciences • médico-sociales IUB • ça n'a rien • à voir avec euh la littérature IUB•IPEB parce qu'en fait • euh j'aime la biologie IUB • et je suis plus • euh • vers la biologie • et euh le social • donc euh • XXX sciences médico- • sociales IUB et donc en • fait euh j'ai choisi italien en deuxième choix IUB • mon premier choix • euh c'était euh psychologie IUB•IPEB* [Rhaps-M1001, Rhapsodie]

‘so um my name is Clara IUB • I am nineteen IUB • I have • obtained my • baccalaureate um so last year IUB•IPEB it's an • SMS bac um • so technological IUB•IPEB it's medico-social • sciences IUB • it has nothing • to do with um literature IUB•IPEB because in fact • um I like biology IUB • and I'm more • um • into biology • and um social issues • so um • XXX medico- • social sciences IUB and so in • fact um I chose Italian for my second choice IUB • my first choice • um it was psychology IUB•IPEB'

Descriptions of itineraries are another example of productions with very few fragmented ISUs and numerous inclusive ISUs. Table 5 shows the distribution of ISUs for our fourteen monologic descriptions of itineraries (with 14 different speakers). It can be seen that the samples form a very homogenous set.

Table 5. Distribution of ISUs for descriptions of itineraries in the Rhapsodie treebank

IUB \ IPEB	0	1	2+
0	61	5	0
1	16	1	1
2+	20	6	1

IUB \ IPEB	0	1	2+
0	55%	4%	
1	33%	8%	
2+			

In these descriptions of itineraries, inclusive ISUs are mainly procedural sequences of actions describing steps in an itinerary, as in examples (15) and (16).

(15) *et • euh • et ces rails • du tram • eh ben je vais • je vais • les longer IUB • je vais traverser • euh • le boulevard Gambetta IUB • ça cette fois c'est le boulevard Gambetta IUB•IPEB* [Rhaps-M0016, Avanzi]

'and • um • and these tracks • of the tram • well I will • I will • walk along them IUB • I will cross • um • Gambetta Boulevard IUB • now this time it is Gambetta boulevard IUB•IPEB'

(16) *euh • il y a un • stade aussi • à côté IUB • et tu arrives à un rond-point IUB • donc là tu rentres dans le centre-ville IUB•IPEB [...] après là c'est indiqué IUB • il y a la • une cabine de téléphone IUB • et voilà • c'est là IUB•IPEB* [Rhaps-M009, Avanzi]

'um • there is a • stadium too • nearby IUB • and you arrive at a roundabout IUB • so there you enter the city center IUB•IPEB […] afterwards it is signposted IUB • there is the • a phone box IUB • and that's it • it's there IUB•IPEB'

Inclusive ISUs can also be due to reformulation as in examples (17) and (18), or correction of the same piece of information as in example (19).[12]

(17) *et • au bout d'un temps vous allez arriver sur une grande place • avec une fontaine au milieu IUB • c'est la place Victor Hugo IUB•IPEB [*Rhaps-M0013, Avanzi]

'and • after a while you will arrive at a large square • with a fountain in the center IUB • it is Victor Hugo square IUB•IPEB'

(18) *c'est pas bien compliqué à y aller hein IUB • vous pouvez pas • vous tromper IUB•IPEB* [Rhaps-M003, Avanzi]

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[12] Such cases are reformulations of a whole IU by another IU, which is different from the case of reformulation presented in Chapter 5 on lists, where only one component of an IU, a governed phrase, is reformulated by another phrase.

‘it is not so complicated to go there is it IUB • you can't • go wrong IUB•IPEB’

(19) *et • euh • je reprends • je crois • le • non c'est pas le boulevard Gambetta IUB • je ne sais pas • lequel c'est • euh IUB • c'est l'autre IUB•IPEB* [Rhaps-M0016, Avanzi]

‘and • um • I recap • I think • the • no it’s not Gambetta boulevard IUB • I don’t know • which one it is • um IUB • it’s the other one IUB•IPEB’

3.4 Fragmented ISUs

Fragmented ISUs are ISUs with internal IPEBs cutting an IU into several IPEs. We observed 21% of fragmented ISUs (Tables 2c and 3), which is much more than the 14% expected with a uniform distribution of the boundaries.[13]

Fragmented ISUs are extremely frequent in official speeches. For instance, [Rhap-M2004], which is a speech by President Chirac, has 79% of fragmented ISUs (emphasized in bold in Table 6). Moreover half of this sample’s ISUs contain more than 3 non-synchronized IPEBs.

Table 6. Profile of [Rhap-M2004, Rhapsodie], a highly fragmented sample

IUB \ IPEB	0	1	2	3+
0	10	4	12	26

[13] p = 26% and p/(1−p) × 0.41 = 14%. See Note 9 for details.

1	0	0	0	1
2+	0	0	0	0

It is interesting to note where the non-synchronized IPEBs occur in Chirac's speech: Only 11% mark a macrosyntactic boundary (the end of a prenucleus), 46% mark the limit between two layers in a paradigmatic list (labelled *para* below). The remaining 43% are breaks inside a syntactic phrase (labelled *dep*). This is illustrated by the most fragmented ISU of our corpus, with a total of twenty-two successive non-synchronized IPEBs; see example (20).

(20) *mes chers compatriotes • IPEB (prenucleus)*
nous avons en commun • certaines valeurs • IPEB (para)
la volonté de donner à chacun sa chance • IPEB (dep)
pour que notre société • soit plus allante • plus • mobile plus optimiste • IPEB (para)
l'exigence de solidarité • IPEB (para)
une solidarité plus responsable • IPEB (dep)
où chacun s'efforcerait de prendre sa part • du contrat • IPEB (para)
l'attachement à la famille • parce qu'elle est • chaleur • entraide • sécurité • IPEB (para)
le désir d'être utile • de trouver sa place • dans la société • IPEB (para)
de donner autour de soi • IPEB (para)
de se réaliser • IPEB (para)
la tolérance • IPEB (dep)
qui ne doit pas être • renoncement • à ses convictions • IPEB (para)
mais respect de l'autre • IPEB (para)
l'esprit républicain • IPEB (para)
et le sens • de l'intérêt général • qui impose • IPEB (dep)
que l'État • conserve • toute • sa place • IPEB (dep)
pour dire • le droit • IPEB (para)

le faire respecter • IPEB (dep)
avec autorité • IPEB (para)
avec justice IUB•IPEB [Rhap-M2004, Rhapsodie]

'my dear compatriots • IPEB (prenucleus)

we share • certain values • IPEB (para)

the will to give everybody their chance • IPEB (dep)

so that our society • will be more active • more • mobile more optimistic • IPEB (para)

the need for solidarity • IPEB (para)

a more responsible solidarity • IPEB (dep)

where everybody endeavours to play their part • of the contract • IPEB (para)

attachment to the family • because it is • warmth • mutual aid • security • IPEB (para)

the desire to be useful • to find our place • in society • IPEB (para)

to give to others • IPEB (para)

to be fulfilled • IPEB (para)

tolerance • IPEB (dep)

which must not be • a renunciation • of our convictions • IPEB (para)

but the respect of others • IPEB (para)

the republican spirit • IPEB (para)

and the sense • of the common interest • that imposes • IPEB (dep)

that the State • preserves • its • full place • IPEB (dep)

to lay down • the law • IPEB (para)

to ensure it is respected • IPEB (dep)

with authority • IPEB (para)

with justice IUB•IPEB'

Chirac's speech also contains ten synchronous ISUs (19%). These ISUs are very short sentences that punctuate the speech and function as slogans as illustrated in example (21).

(21) *un nouvel ordre international • s'affirme peu à peu IUB•IPEB*
[…] nous • réussirons IUB•IPEB

[…] gardons ces exigences IUB•IPEB
[…] la France change IUB•IPEB
elle doit le • faire au rythme du monde IUB•IPEB [Rhap-M2004]

' a new international order • is gradually emerging IUB•IPEB
[…] we • will succeed IUB•IPEB
[…] let's keep these requirements IUB•IPEB
[…] France is changing IUB•IPEB
it must do it • at the same pace as the world IUB•IPEB'

There were only 35% of macrosyntactic boundaries among non-synchronized IPEBs in our set of descriptions of itineraries (seven macrosyntactic boundaries for five paradigmatic boundaries and eight dependency-marked boundaries; see examples (22) and (23). Although these values are too small to be really significant, we think that a larger corpus will confirm that IPEBs on microsyntactic boundaries are specific to oratorical speech.

(22) *je vais traverser le cours • Jean Jaurès • IPEB (postnucleus) si je me • souviens bien IUB•IPEB* [Rhap-M2004, Rhapsodie]

'I will cross the avenue • Jean Jaurès • IPEB (postnucleus) if I • remember well IUB•IPEB'

(23) *donc c'est tout droit IUB • tu verras il y a un arrêt de tram IUB • quand tu • arrives à l'arrêt de tram • IPEB (prenucleus) là tu tournes à gauche IUB • tu suis • la ligne du tram • jusqu'à • jusqu'à • ben jusqu'à La Nef Chavant IUB•IPEB* [Rhap-M0006, Avanzi]

'so it is straight on IUB • you will see there is tram stop IUB • when you • get to the tram stop • IPEB (prenucleus) there you turn left IUB • you follow • the tram line • until • until • well until La Nef Chavant IUB•IPEB'

Note that five of our eight dependency-marked non-synchronized IPEBs are potential epexegeses, that is, new IUs that are microsyntactically dependent on the previous IU. The examples (24) to (26) show relative clauses that work as a new step in the itinerary.

(24) *et je passe sous • le lycée Stendhal • un petit passage • IPEB (dep-epexegesis) qui m'amène • vers le square • des postes IUB•IPEB* [Rhap-M0011, Avanzi]

'I walk under • Stendhal high-school • a little passage • IPEB (dep-epexegesis) which brings me • to the square • of the post-office IUB•IPEB'

(25) *et • je euh je continue • je continue • jusqu'à • une place qui est face à la grande poste • IPEB (dep-epexegesis) où il y a la • euh Chambre de Commerce et d'Industrie IUB•IPEB* [Rhap-M0016, Avanzi]

'and • I um I go on • I go on • until • a square which is in front of the main post office • IPEB (dep-epexegesis) where there is the • um Chamber of Commerce and Industry IUB•IPEB'

Similar constructions are observed in other genres of text, such as narration illustrated in (26).

(26) *j'y suis • restée • pendant quatorze ans • comme euh • euh • sillonnant • le • la la région • a~ a~ • avec euh • mes Peugeot successives • IPEB (dep-epexegesis) qui sont vraiment • les meilleures voitures • pour le Kenya IUB* [Rhap-D2004, Lacheret]

'I stayed • there • for fourteen years • as um • um • travelling • to • to every corner • w~ w~ • with um • my successive Peugeots • IPEB (dep-epexegesis) which are really • the best cars • for Kenya IUB'

3.5 Asynchronous ISUs

Asynchronous ISUs are ISUs containing both non-synchronized IUBs and IPEBs, which result in overlaps of IUs and IPEs. There were 12% of

asynchronous ISUs in Rhapsodie, which is much less than the 25% expected with a uniform distribution of boundaries.[14] In other words, speakers avoid producing alternations of non-synchronized IUBs and IPEBs, that is, overlaps between macrosyntactic and prosodic units.

Nevertheless, the speaker desynchronizes IUBs and IPEBs in some cases. [Rhaps-D2004] is a narration, a life story, where the speaker has to recall facts from the past as in example (27), which seems to be favorable to producing asynchronous ISUs.

(27) *je suis née • à • Cannes • IPEB (dep) pendant la guerre IUB à la fin de la guerre de dix-huit • IPEB (prenucleus) mon • père était au front IUB • et nous avons été chassés d'A~ d'Alsace • naturellement IUB•IPEB* [Rhap-D2004, Lacheret]

    'I was born • in • Cannes • IPEB (dep) during the war IUB at the end of the war of eighteen • IPEB (prenucleus) my • father was on the war front IUB • and we were expelled from A~ Alsace • naturally IUB•IPEB'

Table 7. Profile of [Rhap-D2004], with several asynchronous ISUs

14 100% − (41% + 20% + 14%) = 25%.

IUB \ IPEB	0	1	2+
0	20	2	0
1	7	1	2
2+	9	3	2

We also found a high proportion of asynchronous ISUs in [Rhap-D2013], a broadcast, as in example (28), even though it is planned speech.

(28) *Laurent Joffrin • parle lui aussi • de • désaveu • cinglant • même si dit-il • les responsables de l'UMP • IPEB (dep) s'obstinent à nier • l'évidence • dans un accès • de mauvaise foi • soviétique et dans un festival • de langue de bois IUB • l'UMP • IPEB (dep) voulait • croire à la bourrasque IUB • c'est une tornade IUB•IPEB* [Rhap-D2013, Rhapsodie]

'Laurent Joffrin • also talks • about • a bitter • rejection • even if he says • the UMP officials • IPEB (dep) persist in denying • the evidence • in a fit • of Soviet bad faith • and a festival • of waffle IUB • the UMP • IPEB (dep) wanted • to believe it was just a gust of wind IUB • it is a tornado IUB•IPEB'

In this sample, the asynchronous construction seems to be derived from two factors. First, the structure of the utterance intertwines direct and reported speech in a vocal polyphony where it is not really clear who says what. Second, temporal constraints, derived from the communicative situation (a newscast) where the aim is to give the maximum of information in the shortest possible time, lead to this peculiar phrasing, constructed independently of the syntactic frame.

Table 8. Profile of [Rhap-D2013], a broadcast with a significant proportion of asynchronous ISUs

IUB / IPEB	0	1	2+
0	4	0	1
1	5	0	0
2+	3	4	3

4. Discussion and Conclusion

How syntax and prosody interact to shape the discourse on-line in everyday speech remains a major issue in spoken languages studies. This chapter was devoted to this question, focusing on the maximal units of the prosodic and syntactic interface, called *intonational periods* and *illocutionary units* (IPE and IU) in Rhapsodie. This interplay between major syntactic and prosodic units has been poorly investigated compared to internal units, while it seems to play a crucial role in the functional segmentation of speech and the identification of basic discourse units.

The number of IPEs and IUs is very similar in the Rhapsodie data, but this does not mean that their boundaries are synchronized. A wide range of different combinations was found in the different genres represented in the Rhapsodie treebank. To take this variation into account, we introduced the

concept of *intonosyntactic unit* (ISU), a segment of text between two synchronized boundaries. For such a unit, the question was the following: Do we find one or several boundaries within an ISU, and in the case of several boundaries, what is their nature: syntactic, prosodic, or both? In practice, two constructions were regularly observed: (i) *inclusion*, when an ISU groups one or several major syntactic units only, and (ii) *fragmentation*, when an ISU groups one or several major prosodic units only. It should be mentioned that fragmentation is not significantly less frequent than inclusion and echoes the strategy of fragmentation observed in oratorical speech, for the construction of intonation packages described in chapter 17.[15] More surprisingly, we also observed a third construction that contains both internal prosodic and syntactic boundaries independent of one another, which we called *desynchronization*. The low proportion of such occurrences suggests that, all other things being equal, speakers avoid producing an alternation of non-synchronized IPEBs and IUBs. In fact, this construction seems very specific to certain kinds of speech such as reported speech, fast aloud reading or narration of facts that happened a long time ago, where memories emerge in a piecemeal fashion (one idea at a time, Chafe 1994), and where the prosodic shaping follows the movement of thought. Systematic analyzes on these asynchronous constructions - their frequency,

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[15] See also Chapter 10 for illustrations.

underlying discourse constraints, and effects on the listener's interpretation - need to be carried out on a larger dataset. Lastly, and beyond these very specific contexts, mismatches between prosody and syntax highlight the function of prosody in shaping the information flow (discourse framing, topic and focus marking etc.)[16] and marking discourse relations (spatial, temporal, causal, etc.), and therefore highlight the importance of prosodic phrasing to semantically process macrosyntactic units accurately. We also assume that, in the context of a non-synchronized boundary, the nature of the construction, fragmentation or inclusion, guides the listener's interpretation in terms of semantic and informational continuity or discontinuity between the two segments separated by the boundary, as in examples (29) and (30).

(29) *qu'est-ce • que vous lisez en ce moment IUB je • cherche le livre • que lit Pascale Ferran IUB•IPEB* [Rhap-D2002, Rhapsodie]

'what • are you reading right now IUB I • want to know what book • Pascale Ferran is reading IUB•IPEB'

(30) *c'était de très • grands noms • IPEB qui polarisaient • toute une activité • toute une séduction • culturelle IUB•IPE* [Rhap-D2007, Mertens]

'it was very • famous names • IPEB who attracted • a range of activity • exerted great cultural • seduction IUB•IPE'

In (29), a public dialogue, the turn of the speaker, the journalist, is segmented into two IUs. The first IU is a question addressed to the French

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[16] See Chapter 10 for illustration.

movie director Pascale Ferran and the second IU should be interpreted as a reformulation of the first one, addressed to the listeners of the radio program, and semantically equivalent to the information in the previous IU: There is no informational progression, no new idea, no new discourse topic. The two IUs are both parts of one and only one epistemic stance and this is marked by their intonational inclusion. Conversely, in contexts of fragmentation, the second IPE should not be seen just as a reformulation but as an explanation, or an elaboration of the previous one: The information is detailed, as in example (30).

To sum up, this formal study lays the foundations for the next step of our research program: First, to extend this work to all the units of the prosodic and macrosyntactic trees (e.g. frequency of prenuclei finishing with an intonational period boundary; frequency of prenuclei finishing with an intonation package boundary; frequency of prenuclei with no intonational boundary, etc.); second, as regards functional constraints (information structure marking, semantic relationships, illocutionary parameters, etc.) and form-function pairing, to distinguish general tendencies from constructions correlated with specific genres.