

Tonal and Phrasal
Structures
in French Intonation

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Chapter 1 Introduction

on ri:diŋ ðə frɛŋʃ trənskri:ʃn əv E. Paraige [...], wʌn kænɒt blʌt bi strʌk baɪ ðə rɛɡjʊləri:ti in ði insidəns əv ði æksənt. it si:mz tə fə:l wið insɪstənt mənɒtəni ɒn faɪnl siləblz [...] ənd wʌn ɪz tɛmtɪd tu ɑ:sk – dʌz sʌtʃ dræb seɪmnɪs ri:əli ɪgzɪst in ə lɪvɪŋ læŋɡwɪdʒ?

On reading the French transcription of E. Paraige [...], one cannot but be struck by the regularity in the incidence of the accent. It seems to fall with insistent monotony on final syllables [...] and one is tempted to ask – does such drab sameness really exist in a living language?

- Stephen Jones in *Maître Phonétique* 40 (1932), p.74

The “insistent monotony” referred to in the above quotation is probably the most striking characteristic of French prosody for a speaker of a Germanic language. In Germanic languages, the location of the accented syllables in an utterance varies much more than in French. In a neutral reading of the utterance *We investigate French intonation*, for instance, accents can be realised on the syllables *-ve-*, *French* and *-na*. If the word *intonation* is replaced with *prosody*, the antepenultimate instead of the penultimate syllable of the utterance will be accented. This is because the location of the stressed syllable varies between words in English, and speakers have to know for each word whether stress falls on the final, the penultimate or the antepenultimate syllable of the word.¹ This is not the case in French, because all words have final stress (‘fixed stress’, Garde 1968).² Thus, in *Nous recherchons l’intonation du français*, the syllables *-chons*, *-tion* and *-çais* will be accented in a neutral reading, and if *intonation* is replaced by *prosodie*, or any other word for that matter, the accent will still fall on the final syllable of the word. This is probably why Stephen Jones thought that French sounds “drab”.

Nevertheless, accentuation also varies in French. As in English, syllables with secondary stress can be accented. For instance, *recherchons* can have an additional accent on *re-*. Secondary stress usually falls on the first syllable of lexical words with more than two syllables (cf. Chapter 4 section 4.2). Whether or not a stressed

¹ In this study, the term ‘stress’ refers to the prominence relations between the syllables of a word in terms of metrical strength. ‘Accent’ is used to indicate the intonational phenomenon whereby some of the stressed syllables show melodic variation (often accompanied by changes in duration and amplitude). In other words, stress determines which syllables can be accented.

² In words which end in a schwa, the penultimate syllable is stressed (e.g. *livre* ‘book’, *recherche* ‘investigate’). However, since word-final schwas are not normally pronounced, the accent can be said to coincide with the final syllable of the word.

syllable is actually accented depends on a number of factors. There is a general consensus that the most important factor in French is word grouping. That is, groups of words that are grammatically and/or semantically related are obligatorily marked by a final accent, and all other accents in the group are optional. However, since different definitions of the word-group are proposed in the literature, there is no agreement about the location of the obligatory accents in the utterance. Moreover, conflicting claims are made about the conditions on the realisation of optional accents. As a consequence, it is unclear which accentual patterns are acceptable in French, and which are not. It is important to know what the patterns are, because they play a crucial role in intonation, the topic of this study.

The term ‘intonation’ refers to melodic variation in speech. Melodic variation is not random; speakers decide how and when they produce a melodic change. For instance, *Anna* can be pronounced in various ways in English, as is shown in Figure 1. It matters whether the intonation contour is falling, rising, or rising-falling-rising, because it can change the interpretation of the utterance (e.g. the speaker is making a statement instead of a question, or he is rather surprised or irritated).

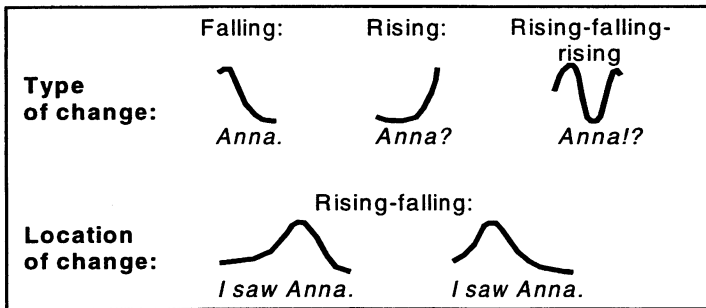


Figure 1: Different intonation contours on *Anna* and *I saw Anna*.

Figure 1 also shows that the location of the change can vary, while the type of change is the same. Both realisations of *I saw Anna* have a rising-falling contour, but the speaker has decided to accent *saw* instead of *Anna* in the second case. However, not all differences between intonation contours are important. For instance, if the first rising part of the rising-falling-rising contour on *Anna* in Figure 1 is omitted, the contour still is essentially the same. Whether a particular difference is categorical or not varies from language to language. Despite the rather large body of literature on French intonation, there is no agreement about which differences between intonation contours are categorical. More specifically, the descriptions disagree about how the direction and the location of the melodic changes can be varied to produce a distinct intonation contour.

This study aims to resolve this controversy by providing a comprehensive description of the tonal structure of French intonation contours and its association with the ‘text’ (the segmental structure). The stressed syllables and boundaries of the segmental structure determine at which locations melodic changes can occur, and the

tonal structure specifies how the melody can be varied at those points. Thus, the description makes clear predictions about the nature of the difference between any intonation contours (i.e. categorical, or gradient within some category), and can be experimentally verified. In addition, the distribution of pitch accents is described. That is, the description specifies how the interaction between factors such as word grouping and the location of the stressed syllables determines at which locations melodic changes occur (i.e. the accentual pattern).

The following section presents the starting points of the study, and some issues that are involved in the investigation of French intonation. The research questions are specified in Section 1.2. Section 1.3 provides a brief discussion of the methodology. The main findings of the study are summarised in Section 1.4. Section 1.5 presents some issues in French prosody and intonation that are not dealt with here. Section 1.6 concludes the chapter with an outline of the study.

1.1. Background

In this section, we will refine the definition of intonation given above by briefly discussing the production and perception of intonation, and the assumption of a difference between phonetic realisation and phonological categories. Then, the association between intonation contours and text is discussed to clarify the relevance of the issue of pitch accent distribution to the description of French intonation contours.

1.1.1. The production and perception of intonation

An important assumption that is made in this study is that intonation is primarily concerned with variations in pitch, although changes in pitch are often accompanied by changes in duration, loudness and voice quality (e.g. Bruce 1977; Beckman 1995; for French: Martin 1982).³ Pitch is the perceived rate of vibration of the vocal folds within the larynx; its acoustic correlate is fundamental frequency. That is, if the vocal folds vibrate more quickly, fundamental frequency increases, and higher pitch will be perceived. Pitch is to a large extent independent of the segmental make-up of the utterance. Thus, two different segments, such as /a/ and /o/, can be produced at the same pitch, and two different utterances, such as *Anna* and *Anna came*, can be produced with the same pitch movement.

Nevertheless, fundamental frequency values may be affected by the segmental structure. For instance, voiceless consonants (e.g. /p/, /t/, /f/ and /s/) show up as gaps in the fundamental frequency trace, as the vocal cords do not vibrate during their

³ For instance, Martin (1982) claims that the appropriate acoustic features for the description of non-final intonation patterns in French must be found in the fundamental frequency curves alone, without taking intensity or duration into account, because the latter do not differ significantly when a different intonation pattern is used. Amplitude and time only play a role in final falling patterns, which have a significantly longer duration, lower amplitude, and lower fundamental frequency.

production, and high vowels (e.g. /i/) have intrinsically higher fundamental frequency than low vowels (e.g. /a/), due to differences in the position of the tongue and the larynx. These phenomena are usually referred to as micro-prosodic or micro-melodic effects, and they are not perceptually salient in terms of pitch (for French: Di Cristo 1978 (cited in both of the following); Rossi et al. 1981:39-45; Di Cristo and Hirst 1986). Thus, two fundamental frequency traces that are different to the eye can give the same auditory impression, because the listener automatically neutralises the micro-prosodic differences between them ('auditory sensation' Crystal 1969). In this case, the traces are said to be perceptually equal ('t Hart, Collier and Cohen 1990).

However, it may also be the case that a listener has the same auditory impression of two traces although the differences between them are not neutralised by the auditory system. That is, even when not all of the differences can be attributed to micro-prosodic effects, and some of them can be perceived, they do not affect the listener's interpretation of the pitch trace ('auditory interpretation' Crystal 1969). This means that a description of the intonation contours of a language needs to abstract away from fundamental frequency differences that cannot be perceived, and from differences which can be perceived, but have no effect on the interpretation.

1.1.2. The phonetics and phonology of intonation

The main starting point of this study is that intonation is phonologically structured: intonation contours can be analysed in terms of limited number of discrete, contrasting elements, just like segmentals in speech. In segmental phonology, the inventory of discrete elements of a language contains the vowels and consonants which are capable of differentiating one word from another (e.g. Bloomfield 1935:77-78). For instance, English has the phonemic distinction between /b/ and /p/, as the two can be used contrastively in *bin* and *pin*. The difference between the sounds is systemic; the speaker makes a different choice from the phonological inventory (Abercrombie 1991:55-57). Such phonological differences are categorical in nature. Other differences between speech sounds are non-distinctive, and gradient in nature. For instance, the /p/ in *pin* is usually pronounced with aspiration in English (i.e. [p^h]), but when it occurs at the end of a word, as in *leap*, it is not. The difference between [p] and [p^h] is non-contrastive, because the degree of aspiration cannot differentiate linguistic forms.

We follow Pierrehumbert (1980), Gussenhoven (1884) and others in assuming that there is also a phonology separate from the phonetics in intonation (Di Cristo and Hirst 1996 for French; see Ladd 1996:11-14 and Gussenhoven to appear for discussion). Some variation in fundamental frequency is contrastive, or systematic (O'Connor and Arnold 1968), in which case the difference is to be described in the phonology, and other variation is gradient, in which case it is part of the phonetics. Non-phonological variation in fundamental frequency may arise from a number of factors, such as the segmental structure, the distance between the accents, the location of prosodic boundaries, and topic structure (Steele 1986; Grønnum 1989,

Bruce 1990; Silverman and Pierrehumbert 1990; Van Santen and Hirschberg 1994; Prieto et al. 1995; Rietveld and Gussenhoven 1995; House and Wichmann 1996; Wichmann et al. 1997, Grabe 1998b). For instance, the timing of the peak in an overall rising-falling movement in French has been reported to depend on the segmental structure of the accented syllable and does not affect the interpretation of the pitch movement (Di Cristo 1976; cf. Chapter 5 section 5.2.3). This means that one and the same phonological category (the falling-rising movement here) can be phonetically realised in a number of different ways (the timing of the peak varies). Whether a difference is phonological or phonetic is independent of its 'size'. That is, a small difference in the fundamental frequency trace may change the interpretation of an utterance abruptly, reflecting two different phonological categories, when an apparently much larger phonetic difference can be found to be irrelevant to the listener's interpretation ('t Hart and Cohen 1973).

This view has two important consequences for the way in which we describe French intonation. First, by assuming that intonation is phonologically structured, paralinguistic variation in pitch is excluded from the description. An example of a paralinguistic difference in pitch is given in Figure 2.

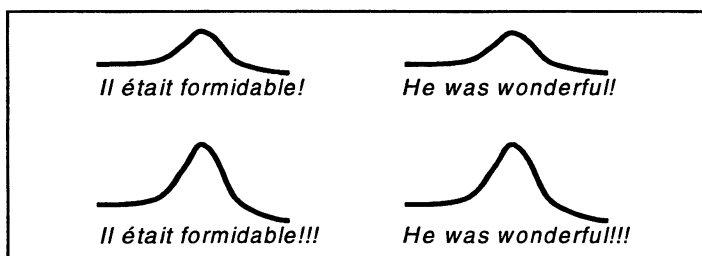


Figure 2: Paralinguistic use of pitch: a greater range conveys greater enthusiasm.

The figure exemplifies that *Il était formidable* 'He was wonderful' sounds more enthusiastic if the speaker increases the range of the pitch excursion (see e.g. Léon 1971 and Fónagy 1983 for intonation and expressiveness in French). This variation is gradient. Although the difference is meaningful, it does not change the linguistic message; that is, both realisations convey a statement. Moreover, the difference can be produced on non-speech sounds such as 'Ehm', in which case it has the same effect of increasing enthusiasm. This indicates that paralinguistic variation is not communicated by means of a formal system, and should therefore not be accounted for in the phonology (Abercrombie 1991:107; cf. Ladd 1996:33-38).

Second, the assumption that intonation is phonologically structured entails that we concentrate on the description of distinct forms rather than functions. A functional approach aims at identifying the characteristics of the functional categories in the language. For instance, falling intonation contours could be said to signal statements, and rising contours questions. However, there is no one-to-one

relation between the forms and the functions of intonation contours. For instance, even though rising contours tend to characterise specific types of questions (e.g. *Did you see him?*), they can also be realised with a falling contour. In a formal approach, the distinct contours are described regardless of their function. Once the structural differences between contours are analysed, one can proceed to investigate how they relate to pragmatic functions. In other words, our phonological analysis does not aim at developing a theory of intonational meaning.

In sum, our assumptions about intonation entail that categorical and gradient variation in pitch should be distinguished in the description, where the former constitute the phonological forms, and the latter differences in the phonetic realisations of these forms. Although gradient variation can also be meaningful, it should be accounted for in the phonetics. The way in which the phonological categories are defined in a description depends to a large extent on assumptions about the association between contours and text.

1.1.3. The association between intonation contours and text

Descriptions of French intonation make conflicting claims about the phonological structure of the intonation contours. This is partly because the authors have different views about the way in which the contours associate with the segmental structure (see Chapter 2 for a comparison of the frameworks). For some, intonation contours are holistic units that each have their own domain (Rhythmic Groups or Sense Groups, sometimes contained in higher-level Intonation Groups). For others, stressed syllables and/or domain boundaries serve as anchors for the turning points of the contours. This means that the structure is primarily defined by the changes in the direction of pitch, or by the location of these changes. As a consequence, different distinctions between intonation contours are made, but also different predictions about where the distinctions can occur. In our proposal, the intonation contours are analysed as high and low turning points which are localised on stressed syllables and boundaries. The following discussion aims to motivate our choice, and to show why a description of the distribution of pitch accents is included in the study.

1.1.3.1. The relevance of accentual patterns to intonation contours

In French, intonation is primarily used to segment speech; that is, it indicates how words are grouped into word-groups and word-groups into utterances. In Figure 3, for instance, the difference between the pitch movements distinguishes *bien* (left) as an adjective, which forms a separate word-group with *C'est*, from *bien* (right) as an adverb, in which case the following material is included in the same word-group (example from Léon 1992).

Both approaches can describe the difference between the contours. In the holistic approach, the example on the left could, for instance, be analysed as a rise on the first Rhythmic Group, followed by a fall on the second group, and the example on the right as one Rhythmic Group with a rise-fall. In a turning-points approach, the same stressed syllables are accented (i.e. marked by a change in pitch), but the

movements are different because of the difference in boundary weight after *bien*. Thus, both approaches can account for the distinction, because only the difference in grouping needs to be referred to here.

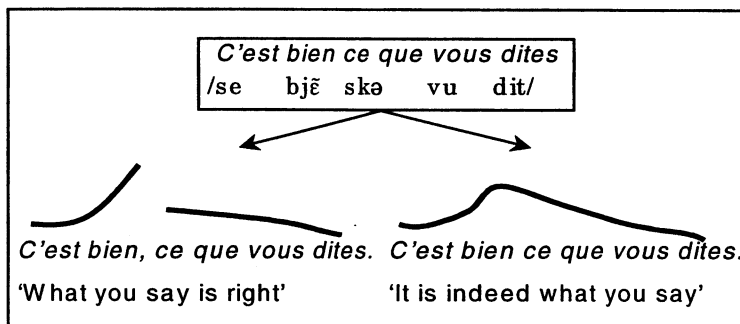


Figure 3: The intonation contours demarcate groups of words.

However, a holistic analysis cannot account for restrictions on the way in which pitch movements can be combined in a Rhythmic Group when a non-final pitch movement is involved. For instance, *C'est une petite fille* 'It's a little girl', which forms one Rhythmic Group, can be realised with a rising-falling movement with a peak on *pe-*, as shown in Figure 4 (a). The utterance can also be realised with an additional pitch peak on *fille*, as in (b).

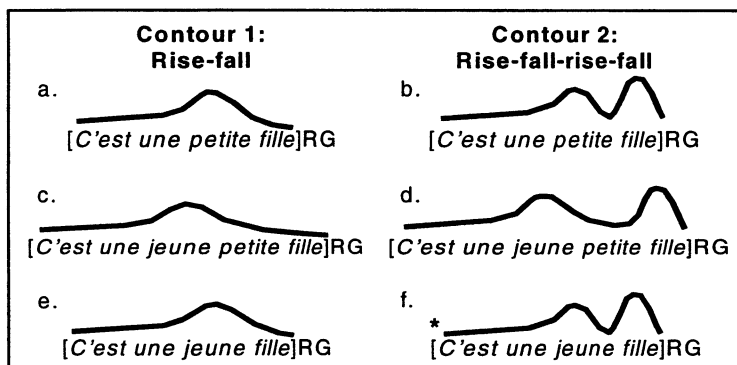


Figure 4: Combinatory restrictions on pitch movements (RG stands for Rhythmic Group).

Since the words still form one Rhythmic Group, we would have to assume that this is a different intonation contour, which we will provisionally call a rise-fall-rise-fall.⁴

⁴ If both pitch movements occurred on a word-final syllable (e.g. *C'est une fille sympathique* with a peak on *fille* and another on *-tique*), they could be analysed as two separate contours, each belonging to their

The same contours can be realised on *C'est une jeune petite fille* 'It's a young little girl', as is shown in Figure 4 (c) and (d). However, examples (e) and (f) show that only the rise-fall is acceptable in *C'est une jeune fille*. That is, the two rising-falling pitch movements cannot occur on immediately adjacent syllables in one and the same Rhythmic Group. This means that the description of the intonation contour needs to specify which syllables can be marked by a change in pitch, and which ones cannot. This problem can easily be solved if the pitch movements are assumed to mark stressed syllables. In that case, we can explain why the contour in (f) is unacceptable: the stressed syllables *jeune* and *fille* are immediately adjacent in the Rhythmic Group, and they cannot both be accented.⁵

Since in the holistic approach, the location of the changes in pitch in the Rhythmic Group is not specified, such restrictions cannot be stated. In the approach adopted here, the ungrammaticality of contours such as (f) can be described, because it can be specified which stressed syllables are accented within the group.

In other words, since some accentual patterns are ungrammatical, the possible forms of the intonation contours are restricted. The question arises whether the conditions can be stated which determine whether an accentual pattern is ungrammatical.

1.1.3.2. Factors that play a role in the distribution of pitch accents

A number of factors interact with each other to determine which syllables are accented. First, groups of words rather than individual words are accented in French, as was mentioned above. For instance, in *Arrêtez-le, voleur!* 'Arrest him, you thief!' *arrêtez* and *le* are grouped together, and in *Arrêtez le voleur* 'Arrest the thief!', *le* groups with *voleur* (the accented syllables are underlined; example from Delattre 1972).⁶ The descriptions of French intonation define this group on the basis of semantic criteria, phonological and/or phonetic criteria, or syntactic criteria. The criteria are often reflected in the terms used to refer to the group (e.g. *Groupe de Sens* Coustenoble and Armstrong 1934; Delattre 1966c; *Groupe Rythmique* Coustenoble and Armstrong 1934; Fouché and Dauzat 1935; Grammont 1966; Delattre 1966b; Ashby 1975; *Breath Group* Pulgram 1965; Vaissière 1992; *Élément Rythmique* Grammont 1966).⁷ The obliteration of word boundaries by phenomena such as Liaison has been claimed to be conditioned by the same domain, i.e. the phenomenon only occurs within the domain, and not across its boundaries (Pulgram

own Rhythmic Group (i.e. [*C'est une fille*]RG [*sympathique*]RG).

⁵ For the contour in (e) see the analyses of Chapters 5 sections 5.2.4 and 5.2.5 and Chapter 6 section 6.2.

⁶ The coincidence of stressed syllables and word-group boundaries has led some authors to deny the existence of word stress in French (e.g. Coustenoble and Armstrong 1934:4; Pulgram 1965:132-133; see Di Cristo 1999 for a discussion). Nevertheless, metrical prominence appears to be relevant to the assignment of pitch movements, as is argued by Dell (1984) on the basis of the different alignment of intonation contours with utterances that end in a final full syllable and those in which the final syllable was a schwa (cf. Chapter 6).

⁷ Some descriptions: "... toute unité de mots qui exprime une idée simple et unique constitue un seul élément rythmique et n'a d'accent que sur sa dernière syllabe" (Grammont 1938:105), "Sense Group is the name given to each of the smallest groups of grammatically related words into which many sentences may be divided" (Coustenoble and Armstrong 1934:3, fn2).

1965; Ashby 1975; Léon 1992).

Second, only stressed syllables in lexical words can be accented (e.g. nouns, adjectives, verbs, adverbs); function words (e.g. prepositions, determiners) are only accented when they occur at the end of the group, or when they are contrasted with another word (cf. Chapter 4 sections 4.1 and 4.2).

Third, the location of the stressed syllables relative to each other plays a role. If they are immediately adjacent, they can only both be accented when there is a major prosodic boundary between them (often marked by a pause, cf. Figure 4 (f); Garde 1968; Verluyten 1982; Dell 1984; Hoskins 1994; Mazzola 1994; Delais 1995). When a non-final and a final accent occur on immediately adjacent syllables in the group, the non-final accent has to be removed (referred to as Clash Resolution).⁸

Fourth, accentuation depends on speaking style and rate of speech (Coustenoble and Armstrong 1934; Grammont 1966; Delattre 1966b; Wenk and Wioland 1982; Vaissière 1974; 1983; 1992; Padeloup 1990a, 1992; Fougeron and Jun 1998). Thus, if a speaker pronounces an utterance very quickly, he will not produce as many accents as in slow and careful speech.

Finally, a speaker can use accents to convey emphasis or to highlight specific elements in an utterance (focus; see Di Cristo 1998 and Di Cristo and Jankowski 1999 for discussion). For instance, *C'est fantastique* with two accents instead of only one on *-stique* sounds more emphatic, and in *J'ai mangé deux tartines*, the speaker stresses that he ate two sandwiches, not one or more (often referred to as contrastive focus). In the latter case, the other words may be deaccented, but this is much more unusual in French than in English (see Cruttenden 1993 for a cross-linguistic study of deaccentuation).⁹

In sum, five factors have been claimed to influence the distribution of pitch accents in French: word grouping, the grammatical category of the words, the adjacency of stressed syllables, speaking rate and style, and focus and emphasis. Recent descriptions of French intonation have claimed that the domain which is marked by an obligatory final accent corresponds to the Phonological Phrase (Verluyten 1982; Delais 1994). The Phonological Phrase has received a formal definition in the theory of Prosodic Phonology (Selkirk 1984; Nespor and Vogel 1986). The same domain has been claimed to condition the application of Clash Resolution (Verluyten 1982; Hoskins 1994) and Liaison (Verluyten 1982; Nespor and Vogel 1982; Booij 1986; Selkirk 1986; Booij and de Jong 1987; De Jong 1994). In view of the importance of the domain to the association between the tonal and segmental structures, we decided to investigate whether the formal definition of the Phonological Phrase is empirically adequate.

⁸ For a possible pattern in which two pitch accents are immediately adjacent in the group see Chapter 6 section 6.2.3.

⁹ The use of accentuation to convey focus is rather limited in French; instead, the syntactic structure of the sentence is adapted. Thus, 'I think John AND Mary should go there' would be translated as *Je crois que Jean devrait y aller, et Marie aussi* instead of **Je crois que Jean ET Marie devrait y aller*.

1.2. The research questions

The questions addressed in this study can be summarised as follows:

- I. When are changes in pitch produced on stressed syllables?
- II. Which changes in pitch occur?
- III. Which differences are distinct?
- IV. How do we present the distinctions in a phonological model?

The first question concerns the interaction between phrasing and accentuation. More precisely, we asked whether evidence can be found for the Phonological Phrase as the domain of the distribution of pitch accents in 'normal' speech (i.e. the utterance has broad focus and is produced at a normal speaking rate in a particular speaking style).

The second question can be narrowed down on the basis of the discussion of the previous section to: which perceived differences in fundamental frequency are produced around stressed syllables and at prosodic boundaries?

The third question asks which variation in pitch is gradient and which is categorical. Once the phonological categories are identified, they can be described in the tonal analysis.

The fourth question asks how the tonal structure can be described such that all and only the categorical differences in pitch movements are accounted for. This means that the description needs to specify how the discrete elements (phonological tones here) can be combined into contrastive contours, and where such combinations occur. The theoretical background of the description will be introduced in Chapter 2

1.3. Methodology

Distinguishing between phonetics and phonology in intonation is not as straightforward as it may seem at first glance. Not all differences in fundamental frequency can be perceived, and when they are, they are not necessarily meaningful (cf. Section 1.1.1). Also, not all meaningful differences represent categorical distinctions (cf. Section 1.1.2). In this section, we will briefly discuss the problem, and how we attempted to resolve it.

1.3.1. Intonational variation and pragmatic meaning

Variation that is used categorically is difficult to tell apart from truly gradient variation in an intonation contour, because the two interact. For instance, a difference in pitch height can represent a categorical distinction at the beginning of an utterance, as is shown in Figure 5 (Grabe et al. 1997). In the figure, the same pitch accents are chosen (L*HH% in Gussenhoven 1991b), but the preceding unaccented syllables are pronounced at a high level (left; 'high onset') or at a low level (right; 'low onset').

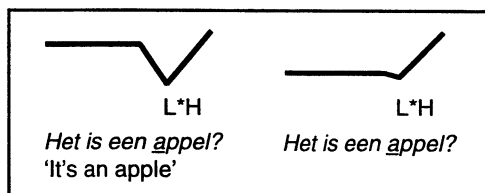


Figure 5: A categorical distinction due to a difference in pitch height in the onset in Dutch.

Differences in pitch height can also be non-distinctive. For instance, the average pitch of men is lower than that of women. This type of gradient variation will interact with the categorical variation in the onset of the examples of Figure 5 to produce varying fundamental frequency values. The criterion for deciding when variation is distinctive is the contribution to the pragmatic interpretation (i.e. changing the values of the onset relative to the pitch accent leads to a different interpretation of the contours; an overall higher or lower realisation of the utterance does not).

However, not all differences in meaning are necessarily phonological in nature (e.g. the paralinguistic use of pitch range to signal increasing enthusiasm in Figure 2). Therefore, pragmatic meaning may not be a reliable source of evidence for phonological contrasts. Also, since there is no generally accepted theory of the relation between phonological forms and pragmatic meaning, meaning-based evaluations of competing phonological accounts must be inconclusive (Ladd 1996:101-102).

Yet, the fact that the intonational categories cannot easily be identified does not invalidate the assumption that phonological forms are distinct from phonetic realisation mechanisms. It does mean, though, that conclusive evidence for the phonological distinctions is difficult to collect. The present study attempts to take this limitation into account by adopting the approach known as laboratory phonology, where the empirical analysis of production and perception data forms the basis of the phonological description.

1.3.2. Outline of the methodology

Two carefully constructed corpora of spontaneous and read speech were analysed auditorily and acoustically. First, the pitch movements were inspected, comparing realisations across speakers and contexts, which resulted in a first classification into discretely different contours. The contours were compared with those described in the literature, and the inventory of contrasting contours was drawn up. Then, the contours were formalised in a phonological description (the tonal analysis of the contours). Finally, the original pitch contours were compared with the contours predicted by the phonological description (see Chapter 5 section 5.1 for further details).

To substantiate the analysis, two perception experiments were carried out on

the assumption that what is analysed as similar in the phonological system should be perceived as similar by the listeners (Gussenhoven 1984:267-287; Gussenhoven and Rietveld 1991). Being discrete, phonological differences were predicted to have strong effects, unlike phonetic differences which are gradient in nature, even when they are meaningful. This investigation concentrated on some of the more controversial cases, since not all predictions made by the analysis could be tested (see Chapter 7 for further details).

One further remark about the methodology are in order. The analyses needed to abstract away from sociolinguistic variation due to, for instance, differences between dialects, speakers, speaking styles and context. Therefore, the investigation was limited to speech produced by a fairly homogeneous group of speakers, comparing their realisations in various contexts and speaking styles. All subjects in this study were academically educated, from the north of France (mostly from Paris), and aged between 18 and 30. We assume that their variety of French is a close approximation of 'General French', which Di Cristo (1998) defines as a non-regional accent without local characteristics, mostly spoken by educated people as well as professional broadcasters (comparable to RP or General American).

1.4. Summary of the findings

The main findings of the study can be summarised as follows (note that the terminology and details of experimental procedure are discussed in the following chapters):

- I. The study provides a coherent phonetic and phonological picture of phrasing and pitch accent distribution. More specifically, the following conclusions are drawn.
 - The application of Clash Resolution is conditioned by the Phonological Phrase.
 - The application of Liaison is not conditioned by the Phonological Phrase.
 - The Phonological Phrase is measurable in the duration of the pre-boundary syllable.
 - Pitch accent distribution is conditioned by the Phonological Phrase: phrase-final accents are obligatory, and clashes between immediately adjacent accents are prohibited.
 - Restructuring of Phonological Phrases is not restricted to lexical heads and their non-branching complements. Rather, Phonological Phrases are mapped onto the projections of X-bar category heads in the morpho-syntactic structure, where factors such as the number of syllables and speaking rate determine whether the Phonological Phrase spans an X' or an X'' projection.
 - A constraint-based analysis accounts for the interaction between phrasing and pitch accent distribution: the grammar predicts which forms surface in cases of prosodic variation, and still excludes categorically ungrammatical output forms.
- II. The study provides a comprehensive account of the tonal structure of French

intonation contours and its association with the segmental structure. More in particular, our findings are as follows.

- Seven categories are identified in Intonation Phrase final position: falling movements to mid and to low, falling movements from a penultimate unaccented peak to mid and to low, rising movements to high and to mid, and rising-falling movements.
- Three categories are identified in Intonation Phrase internal position: a rising, a rising-falling and a falling movement.
- A small set of tonal primitives accounts for the categorical distinctions: two pitch accents, five boundary specifications (two initial and three final), and an optional L-tone.
- There is no need to distinguish between an underlying and surface level in the phonology, since the tones of the underlying structure are not phonologically modified or deleted.
- The distinction between the phonological and the phonetic levels of representation makes explicit predictions about discreteness and gradience in variation in pitch, which can be experimentally verified.
- Differences in attitude can be detected in phonetically different contours representing phonologically identical intonations.

III. The analyses are based on a variety of experimental methods. As a result of our experimentation, a number of conclusions could be drawn.

- A production experiment successfully investigated the interaction between Phonological Phrasing, pitch accent distribution and the application of Liaison.
- Clear hypotheses about French intonational contrasts could be drawn up on the basis of an auditory and acoustic analysis of a speech corpus with two speaking styles.
- Categorical Perception paradigm may be unsuitable for the investigation of intonational contrasts.
- The pragmatic contribution of gradient and categorical variation in pitch was successfully investigated by means of contrastive judgements of attitudinal meanings.

1.5. Some issues that are not addressed in this study

A number of issues in French prosody and intonation are not dealt with in this study. First, no proposal about French foot structure is included in this study, because we found that feet need not be referred to in order to account for the association between the tonal and segmental structures (see Chapters 3 and 4). That is, foot structure may well be relevant to other phonological processes in French, but cannot be motivated on the basis of pitch accent assignment.

Second, the influence of focus on the accentual and phrasal structure of utterances is not investigated. We adopt the view that deaccenting and dephrasing

can take place in utterances with early focus, but that this is by no means obligatory (Di Cristo and Jankowski 1999; Jun and Fougeron to appear).

Third, the study does not investigate the difference between emphatic, focal, rhythmic and demarcative pitch accents. These various functions have been claimed to be consistently related to word-initial as opposed to word-final accents, or to differences in the realisation of pitch movements occurring at either of these locations (see Dahan and Bernard 1996; Di Cristo and Hirst 1997 and Di Cristo 1999 for overviews). We take the position that all pitch movements associated with stressed syllables are pitch accents in the phonology (H^* or $H+H^*$ in the analysis proposed here).¹⁰ Thus, the functional differences are not part of the phonology, although they may affect phonetic implementation (e.g. strong emphasis is often reflected in a higher accentual peak in Germanic languages, and this could be the case in French as well).

Fourth, the study does not cover the phonetic implementation of the tonal structure. We have not investigated how factors such as the segmental structure, the number and location of surrounding pitch accents, the location of prosodic boundaries, and topic structure affect the timing and fundamental frequency values of tonal targets and the transitions between them. Further research is needed for the description to be directly applicable in, for instance, speech synthesis, language learning and forensic research.

Finally, the aim of the study was to describe the phonological aspects of French intonation, not its semantic or communicative aspects. Although they are closely connected, as was explained above, we consider the identification and formalisation of the patterns that are used consistently in French as our first task. As is the case for the interaction between the phonology of intonation and the other components of the grammar (e.g. syntax, morphology), its relation to semantics falls outside the scope of this study. As a consequence, the study's contribution to the development of a theory of intonational meaning must be limited.

1.6. Outline of the thesis

The following chapter is introductory. It presents the theoretical background of the study by comparing previous analyses couched in different frameworks with the Autosegmental-Metrical framework adopted here. Chapter 3 reports a production experiment which investigated the interaction between phrasing and accentuation. In Chapter 4, the distribution of pitch accents is accounted for in the framework of Optimality Theory (Prince and Smolensky 1993). The investigation of Chapter 5 aims at identifying the intonation contours that should be captured by the phonological description. Chapter 6 gives our proposal for an Autosegmental-Metrical account of these findings. The predictions of the analysis and alternatives to the phonological specifications are presented, and its advantages over competing

¹⁰ The assumption that pitch movements associated with word-initial syllables should be analysed as pitch accents is defended in Chapter 3 section 3.3 and Chapter 6 section 6.4.

autosegmental accounts of French intonation are discussed. Some controversial predictions of the account are experimentally tested in Chapter 7.

Chapter 2 Theoretical background: modelling

The complete list of all melodies that are produced on utterances in a particular language might constitute an observationally adequate description, but would not be a descriptively adequate analysis (Chomsky 1970). That is, it cannot provide a meaningful account of intonation, because it fails to capture generalisations about intonation contours both within the language in question and across languages. As was explained in the previous chapter, intonation is an autonomous system with an internal structure. For an analysis to be descriptively adequate, this structure needs to be defined. In other words, what is the nature of the elements that can be combined in the system, and what are the primitives?

Different approaches to the decomposition of intonation contours into discrete elements have been chosen, ranging from configuration-based analyses to analyses in terms of distinct pitch levels ('global' versus 'atomistic', Bolinger 1951). Examples of the former are the Dutch approach developed at the IPO (Collier and 't Hart 1981; 't Hart et al. 1990), and what is generally referred to as the 'British tradition' (e.g. Halliday 1967; O'Connor and Arnold 1968; Crystal 1969). Here, the intonation contour of an utterance consists of a sequence of discrete pitch movements (e.g. rises and falls). The movements are the primitives of the intonation structure; at the phonological level, the inventory of the movements and the way in which they can be combined is given. Examples of the levels approach are American structuralist descriptions (e.g. Pike 1945; Trager and Smith 1951), who decompose the intonation contour into its component levels, usually four (Low, Mid, High and Extra High, indicated by numbers). The Autosegmental-Metrical approach adopted in this study is an exponent of the levels approach, because it also analyses pitch movements in terms of pitch levels (for a comprehensive overview see Ladd 1996:42-112). The main differences with the levels approach are that it recognises only two levels in the phonology, the minima and maxima of the contour (High and Low tones), and that the way in which they are associated with the text is formally specified. When they are associated with the text, each tone has its phonetic target. These targets are then connected through phonetic transitions to form the surface melodic contour. Thus, the analysis can make reference to the turning points in the contour (the levels), while capturing the fact that only some configurations of tones are distinctive (the pitch accents and boundary tones). The same array of frameworks has been applied to the analysis of French intonation.¹

The French analyses also vary along a second dimension: from functional to

¹ Configuration-based descriptions are Coustenoble and Armstrong (1934), Pulgram (1965), Vaissière (1974, 1975), Crompton (1978), Kenning (1979), and Beaugendre (1994), and those which refer to distinct pitch levels in the contours are Delattre (1966b, 1972), Léon (1971, 1992), Martin (1975b, 1977, 1987), Rossi (1985). Autosegmental accounts have been proposed in Hirst and Di Cristo (1984), Mertens (1986, 1987, 1990), Post (1993), Di Cristo and Hirst (1996), and Jun and Fougeron (1995, to appear).

formal. In a functional approach, the aim is to identify intonation contours which characterise functional categories such as statements and questions, whereas in a formal approach, the linguistically relevant differences between intonation contours are defined regardless of the way in which they are used in the language. As was pointed out in the previous chapter, a phonological description primarily aims at identifying the inventory of contrasting forms rather than attributing specific forms to functions, because one form can have various functions, and vice versa.

In this chapter, an Autosegmental-Metrical approach to the analysis of French intonation will be motivated. Three earlier descriptions of French intonation will be discussed in the following section, outlining their basic assumptions and the main arguments that can be raised against them. In section 2.2, the Autosegmental-Metrical framework is presented, and two Autosegmental-Metrical proposals for French are reviewed. The discussion leads to the formulation of the research questions addressed in Chapters 3 and 4, and Chapters 5 and 6, respectively (Section 2.3).

2.1. Earlier descriptions of French intonation

The descriptions discussed below are chosen because they aim to provide a comprehensive account of all contours in French. They serve to illustrate the differences between the various approaches, and thus allow us to clarify the starting-points of our analysis. The first description is configuration-based, analysing intonation in terms of holistic contours. The second is a pitch-levels analysis, in which the distinct pitch movements are defined from a functional perspective. The third description is closer to the Autosegmental-Metrical framework, because it also analyses the contours in terms of High and Low tones.

2.1.1. Coustenoble and Armstrong (1934)

Coustenoble and Armstrong provided the first reasonably comprehensive description of French intonation. It is a more elaborate version of the relevant chapter in Armstrong and Jones (1932), and both were written for teaching purposes, aimed at English students of French. The authors distinguish three global contours in unemphatic speech: (1) rise-falling intonation, (2) falling intonation, and (3) rising intonation, exemplified in Figure 1.

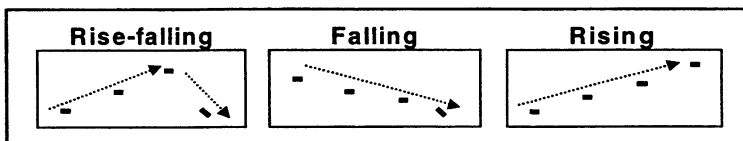


Figure 1: The global intonation contours of French according to Coustenoble and Armstrong (1934).

The highest point in the rise-falling contour is reached on the penultimate syllable. The contour is mainly used in short assertions. In the falling contour, which is typically used in question-word questions and commands, the highest pitch is realised on the first important word in the utterance (e.g. the question-word). The rising contour is used in statements with implication and questions.

The contours are claimed to characterise 'Intonation Groups', which can be 'broken' in longer sentences. The Intonation Groups appear to be defined on the basis of the global characteristics of the intonation contour. An example of a 'broken' Intonation Group is given in Figure 2. The figure shows that in 'broken' Intonation Groups, the direction of the curve suddenly changes upward before returning to the original direction (here falling; Coustenoble and Armstrong 1934:60-61). The sudden changes occur at the end of Sense Groups, which are defined as a "...group of words (sometimes one word only) having in itself a certain sense, not necessarily complete" (Armstrong and Jones 1967:132, also Grammont 1938:105).

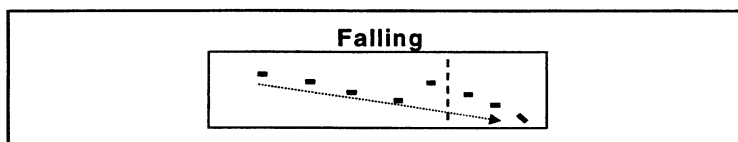


Figure 2: A falling contour in a 'broken' Intonation Group. The dotted line indicates the break realised between the Sense Groups.

The different ideas expressed in the utterance can be given more prominence to by marking each Sense Group in this way, or by dividing the utterance into several Intonation Groups (Coustenoble and Armstrong 1934:75). For instance, in a rise-falling contour, the highest point will occur after the introduction of the main idea, and the falling part gives an impression of completeness about this idea. The location of the highest point varies within and across speakers (Coustenoble and Armstrong 1934:88), as is shown in Figure 3.

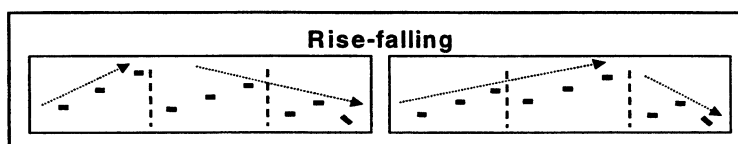


Figure 3: A rise-falling contour on an utterance with three groups. The dotted lines indicate the boundaries between the groups (coincide with Sense Groups).

When the rise-falling and the falling contour are followed by an "expression of small significance" such as *dit-il*, and *monsieur* (often referred to as appendices), its pitch

is low level or slightly falling, and when the contour is rising, the appendix is also rising. Note that the appendix is not presented as a separate contour (cf. Delattre's *echo* and *parenthèse* below).

Clearly, pitch movements are described as holistic units here, predefined chunks of intonation. The description abstracts away from the details in the contours, and their internal structure is left largely unanalysed.² Thus, the description does not formalise the relation between the contours of Intonation Groups that are embedded in a larger Intonation Group and the global contour of the utterance as a whole. For instance, the global rise-falling contour of Figure 3 appears to consist of two rises followed by a rise-fall. Would the global contour still be classified as a rise-falling contour if the last Intonation Group was falling or rising? Also, can the rise-fall of the final group be preceded by other rise-falls, or by falls instead of rises? In other words, it is unclear how the contours can be combined in an utterance, and to what extent these choices are distinct.

The description also illustrates a more general drawback of the configuration-based approach, which is that it does not reflect the importance of the location of the turning points in the contour (Ladd 1996:64-66). For instance, a fairly consistent difference in the pitch level of the end-point of rising movements has been reported in French questions and continuations (used to signal that the utterance is not yet complete; cf. Chapter 7 section 7.1.1.2). Such differences cannot be captured in a configuration-based approach, because only changes in pitch can be represented. Also, whether the peak in a globally rising-falling movement is located at the end of a non-final group, on the penultimate syllable of a group, or in the final syllable cannot be expressed, although these differences are significant in French (see Chapter 5 section 5.2 for a discussion). Thus, the description cannot capture the consistency in the pitch levels and the temporal alignment of pitch movements, because the internal structure of the contour is not formalised.

2.1.2. Delattre (1966b, 1972)

The most influential description of French intonation is probably Delattre's. He analyses melodic contours in terms of four distinct pitch levels, identifying ten different intonation contours. The contours are given in Figure 4. Apart from the contours with a fall from level four, which are "not clearly distinctive among themselves", all contours are discrete units (Delattre 1972:171). The units are defined on the basis of the pitch levels at which they start and end, with the exception of the rises to level four, which differ in the changing rate at which they rise (increasing in the *question* and decreasing in the *continuation majeure*, i.e. convex as opposed to concave) or in the end-point (falling in the *implication*).

² The aim of the authors was to teach English students how to produce French intonation contours and when to use them, not to provide a phonological description. Nevertheless, the approach leads to some confusion.

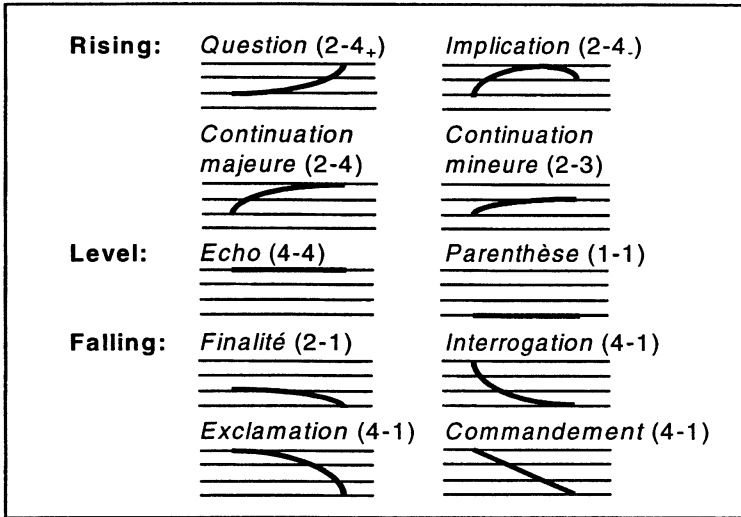


Figure 4: Delattre’s *dix intonations de base* ‘ten basic intonations’.

The categories are distinguished on the basis of their grammatical function, which is reflected in their labels. Figure 5 exemplifies how an utterance is decomposed into three contours (the pitch movements are represented as stylised contours).

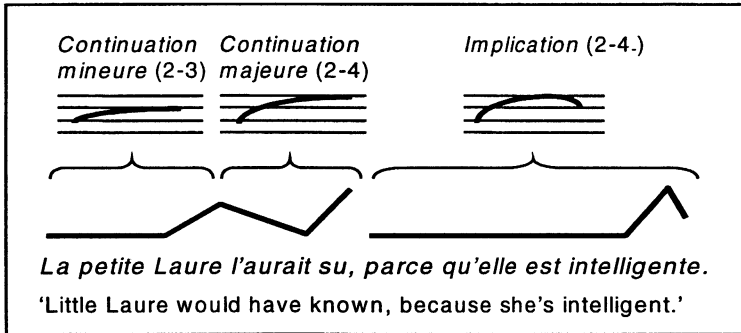


Figure 5: The functions of the intonation contours: (1) minor continuation contour, (2) major intonation contour, and (3) implication contour.

Minor intonation contours mark non-final Rhythmic Groups, or Sense Groups, which Delattre defines on semantic grounds in the way Coustenoble and Armstrong do. The function of the major continuation contour is to indicate that two Rhythmic Groups are grouped together into a larger unit of meaning (Delattre 1972:169). The third rising-falling contour (*intonation d’implication*) implies that the listener did or

should have known that Laure is intelligent, and contrasts with the neutral utterance-final fall which conveys finality (*intonation de finalité*).

The implicit assumption of Delattre's inventory that there is a one-to-one relation between form and grammatical function leads to the specification of too many phonological categories on the one hand, and on the other, it misses some linguistically relevant differences between the contours. For instance, rising movements to level four can be used to signal different grammatical functions, and the description expresses this as a formal difference between convex and concave rises. However, this difference is by no means consistent (discussion in Chapter 5 section 5.2.2.). Also, it misses formal distinctions which do not signal differences in grammatical structure, such as the difference between falls to low and falls to the middle of the speaking range, which can both be used in statements (Chapter 5 section 5.2.4). Delattre presumably analyses them as the same category (*intonation de finalité*), since no mention is made of falling movements that do not reach the bottom of the speaking range. Finally, the restrictions on the way in which the contours can be combined are not specified. A correct inference is probably that only the *continuation mineure* and the *continuation majeure* can occur in Rhythmic Groups that are non-final in the utterance, but this restriction does not follow from the description.³

In addition to approaching intonation from a functional perspective, Delattre's analysis is couched in the pitch-levels approach, which again leads to missed generalisations in some cases, while positing too many phonological categories in others, since the intonational events are not formally related to specific points in the temporal domain. This is a characteristic it shares with Coustenoble and Armstrong's configuration-based approach. Despite the introduction of distinct pitch levels, the contours are essentially holistic units which are only vaguely associated with Rhythmic Groups. This means that the consistency in the temporal alignment of the contour cannot be expressed. On the one hand, a number of intonation contours cannot be described at the phonological level. In addition to the peak-timing example discussed at the end of the previous subsection, pitch movements that do not occur at the end of a Rhythmic Group (e.g. at the beginning of a word) cannot be analysed in Delattre's approach. On the other hand, the specification of contours at four pitch levels results in too many distinctions, and thus, some apparent similarities between the contours are not captured in a parsimonious way. For instance, the *continuation mineure* is distinguished from the *continuation majeure* at the phonological level. The only formal difference between them is a difference in the final pitch level. Although this difference is very likely to be systematic in the phonetics, it does not need to be included in the inventory of phonological forms, because it can be explained on the basis of the prosodic structure of the utterance (in terms of phrasing and accentuation), as will be shown in Section 2.2. Moreover, the

³ Also, since Delattre states that the *continuation mineure* can take the form of a fall (Delattre 1972:169), we have to conclude that contours other than rises to level 3 and 4 are apparently allowed in this position. The stipulation that the *continuation mineure* can be rising or falling also suggests that certain forms have more than one function.

assumption of four distinct pitch levels as primitives in the description predicts a number of configurations that do not exist (cf. Bolinger 1951). The question arises why configurations like '1-3', '4-1', and '1-4-' exist, while '3-1', '4-3' and '1-2-' do not. In other words, the number of levels is arbitrary; Léon has five.

2.1.3. Mertens (1986, 1987, 1990)

In a more recent treatment of French intonation, Mertens proposes to analyse intonational contours in terms of a sequence of tones (High and Low) that are each linked to a syllable. When they are associated with stressed syllables, the tones are indicated by higher case in the transcription, and are defined at four different pitch levels, H, L, H⁺ and L⁻, where H⁺ and L⁻ represent the extremes of the speaker's pitch range. Word-initial and word-final pitch movements are assumed to be phonologically distinct, transcribed as a specification with one as opposed to two tones, as can be seen in Figure 6, and this reflects the difference in duration between word-initial and word-final accents (word-final accented syllables are usually longer). In addition, unaccented syllables are tonally specified, indicated by lower case in the transcription. This analysis results in an inventory of the thirteen different elements given in Figure 6, referred to as 'morphemes' by Mertens. However, since many of the tones of the morphemes can also be raised or lowered (e.g. \HH for a word-final accent), we are not sure how many different phonological categories are being defined.⁴

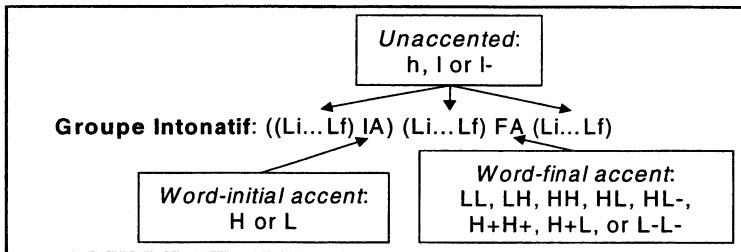


Figure 6: Mertens' tonal categories and their distribution in the intonation group. Curly brackets indicate the optional elements in the intonation group, 'Li' and 'Lf' stand for the initial and final location of the sequence of unaccented syllables.

Every word-final accent marks the end of an Intonation Group. The size of the Intonation Groups (i.e. the location of the word-final accents) is conditioned by the syntactic structure, but their formation also needs to respect certain morphological and phonological constraints (see Mertens 1993a for a discussion). The way in which

⁴ Since the word-initial accent is rarely L, Mertens does not list this specification in all of his articles. Also, l- is given as a possible specification for unaccented syllables, but Mertens claims that it can only occur in appendices.

the tonal morphemes can be combined depends on a number of factors, such as the identity of the tones (e.g. appendices only occur after certain types of word-final accents), the number of syllables in the Intonation Group and, again, the syntactic structure (Mertens 1993a). For instance, consecutive Intonation Groups can be grouped together, which relation is indicated by the value of the final accent of the second group. That is, the tones are hierarchically organised, where L- dominates H+, both dominate H, and all three dominate L (Mertens 1990:169-171). Thus, in Figure 7, the final accents of the three Intonation Groups reflect the hierarchical relations between them. We have applied Mertens' analysis to the utterance that illustrated Delattre's account in the figure (cf. Figure 5).⁵

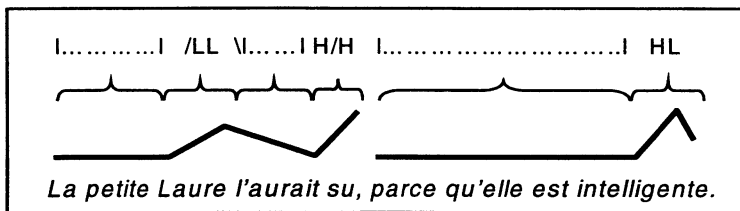


Figure 7: Example of Mertens' account. '∨' and '/' indicate lowering and raising, respectively.

The tonal specification on *su* dominates that on *Laure*, which in turn is dominated by the configuration on *-gente*.⁶ The hierarchical relations expressed by the tonal structure have to be congruent with the syntactic structure.

Mertens' description is observationally adequate, in that it gives a detailed account of the phonetic realisation of the intonation contours, but this degree of phonetic detail is unlikely to reflect the system of phonological contrasts. Figure 7 illustrates that it fails to capture the similarity between the movements on *Laure* and *su*, which are given very different tonal specifications. Thus, like Delattre's account, it ignores the fact that some characteristics of the intonation contours are predictable, as was argued above.⁷ Also, the fact that unaccented syllables are specified for tone reduces the predictive value of the model. There is no need to specify the tonal value of every single syllable, because if left unspecified, they can automatically be assigned their correct values in the course of phonetic implementation (Pierrehumbert 1980). The same applies to the tones associated with the word-final

⁵ The transcription is our interpretation; the details may not be entirely correct, as Mertens illustrates his transcriptions by means of a representation of his auditory impression of the intonation contours that is very similar to Coustenoble and Armstrongs', instead of using contours or F0 traces (e.g. '∨...∨' in Figure 7 might in fact be 'h...l' in Mertens' view).

⁶ We are not entirely sure that HL dominates /HH in Mertens' view.

⁷ As will be shown in the following section, we agree with Mertens and Delattre that the movements should have different tonal representations, but the difference is attributed to a difference in boundary weight, and not to a different specification for the pitch accent, as Mertens does. Thus, the similarity of the movements can be captured, and the analysis is more parsimonious.

syllables, which Mertens defines at four different levels (cf. the objections raised against Delattre's four levels). In other words, the description does not clearly separate the phonetics and phonology of intonation.

2.1.4. Concluding remarks

The grouping of words - whether defined on semantic (e.g. Coustenoble and Armstrong, Delattre) or syntactic grounds (e.g. Mertens) - is generally assumed to be an important factor in the location and the nature of the intonational events in French. It affects the distribution of pitch movements in an utterance, and the way in which they can be combined. This strongly suggests that a descriptively adequate model of French intonation should formalise the association between the intonation structure and the text. In our view, this can be done more successfully in the Autosegmental-Metrical approach, because the distinction between pitch accents and boundary tones allows the account to be more parsimonious. The discussion also revealed that the absence of a clear distinction between the phonetics and the phonology of intonation obscures the phonological differences between pitch movements in previous analyses.

We aim to show that French intonation can be phonologically analysed by means of two phonological tones, High and Low, which are associated with the text in a principled way. This analysis posits a smaller phonological inventory than did earlier analyses. The analysis claims to predict all and only the intonational contrasts of French, while being explicit about the ways in which the phonological structures are pronounced in different contexts.

2.2. The Autosegmental-Metrical framework

In the Autosegmental-Metrical framework, intonation contours are analysed as linear sequences of locally specified targets which are linked up by means of phonetic transitions (Pierrehumbert 1980; Pierrehumbert and Beckman 1988; and others). The phonetic targets correspond to tones (High or Low) in the phonological representation, and these tones associate with metrically strong syllables (T*) or the boundaries of prosodic units (T%).⁸ The inventory of pitch accents and boundary tones may vary from one language to another. The model leaves the stretch of speech between pitch accents and boundaries unspecified for tone. Along with the phonological tones, this stretch receives its surface fundamental frequency value in the course of phonetic implementation, when pitch is interpolated between the targets. The way in which the tonal targets are phonetically realised is defined by a

⁸ Whenever we use the term '(pitch) accent' in this study, we refer to the set of tones of the intonation contour that associate with metrically strong syllables. The term 'stress' refers to the metrical prominence relations that hold between syllables (the metrical structure). Thus, stress is the potential for accent: accented syllables are also stressed, but stressed syllables do not have to be accented (cf. Bolinger 1972:22).

set of language-specific implementation rules.

In Figure 8, the analysis is exemplified for the utterance of Figures 5 and 7 (the details of the analysis will be discussed in Chapter 6). As is shown in the figure, the contour is decomposed into pitch accents and boundary tones. The starred tones associate with the accented syllables *Laure*, *su* and *-gente* (the final schwa is not normally pronounced), and the boundary tones associate with the edges of the two Intonation Phrases of the utterance.

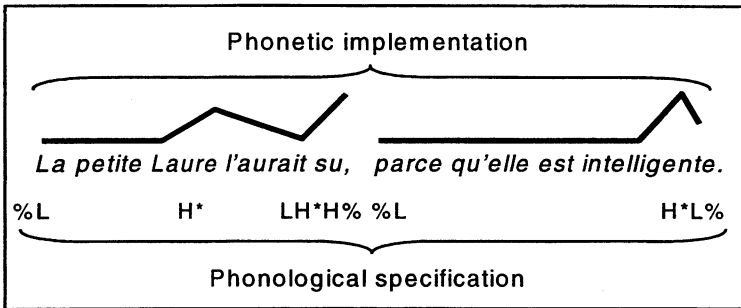


Figure 8: Example of an Autosegmental-Metrical analysis of a French utterance (the phonetic representation in terms of fundamental frequency is represented as a stylised contour).

Relative to the descriptions discussed in the previous section, the analysis has several advantages. First, there is no need to specify the tonal value of every single syllable, because, if left phonetically underspecified, many can automatically be assigned their correct values in the course of phonetic implementation. Thus, the number of tones needed to specify a contour can be smaller than the number of syllables in the text. As a result, the model can account for the fact that the contours presented in Figure 9 are phonologically identical, although their phonetic forms are different (Ladd 1996:44).

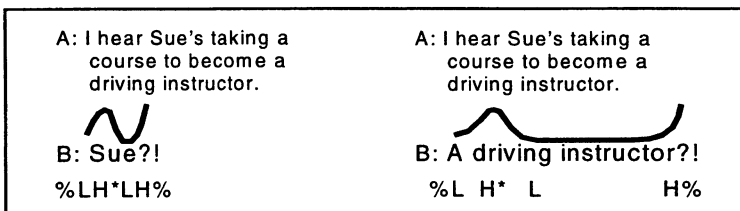


Figure 9: Underspecification: phonologically identical analyses for phonetically different forms.

The example shows that the slope and the length of the transitions between the tonal targets depend on the number of intervening syllables. Thus, underspecification

allows the analysis to capture the similarity between the contours, because phonetic realisation is systematic.

Second, the difference in duration of the accented syllables does not need to be specified in the tonal analysis, as Mertens does, because the longer duration of pitch accents at the end of a prosodic constituent depends on the rank of the following constituent boundary. In other words, pre-final lengthening is a prosodic, and not a tonal phenomenon (cf. Chapter 6 section 6.4).

Third, the similarity between intonational forms can be expressed more transparently, because they are decomposed into separate tonal elements. For instance, the rising pitch movements on *Laure* and *su* in Figure 8 have the same pitch accent H*, but the difference in peak height is attributed to the H% boundary tone that follows the H* on *su*. As a consequence, fewer phonological categories are needed to account for the intonational forms. Thus, the analysis reflects the more general principle of economy in capturing all contrasts in the data by means of the smallest number of possible categories.

Fourth, the hope exists that an adequate phonological analysis will be readily interpretable in terms of morphemic units. The assumption is that the tone strings that characterise the intonation contours of the Intonation Phrase consist of (monotonal or polytonal) morphemes, each of which makes its own, independent contribution to the interpretation of the utterance (Gussenhoven 1984:193-258; Pierrehumbert and Hirschberg 1990). In this study, however, no attempt will be made to formulate such a functional, morphemic analysis.

In the remainder of this section, two Autosegmental-Metrical accounts that have been proposed for French are presented.

2.2.1. Jun and Fougeron

According to Jun and Fougeron (1995, to appear), French intonation is organised into the three prosodic levels of the Accentual Phrase (AP), the Intermediate Phrase (ip) and the Intonation Phrase (IP), as is shown in Figure 10 (cf. Jun and Fougeron to appear).

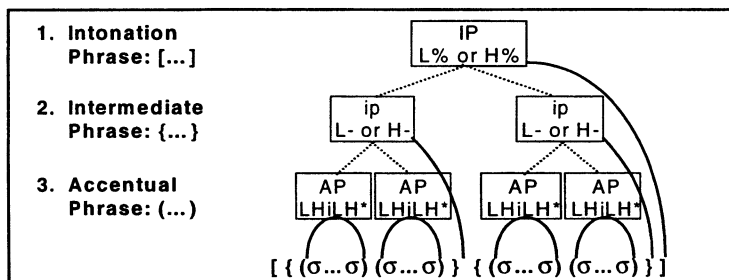


Figure 10: Illustration of Jun and Fougeron's three-layered prosodic structure.

The tonal specification of the AP is LHiLH*. The H* tone associates with the last full syllable of a lexical word, i.e. the syllable with the primary stress, and the Hi tone associates with the first or second syllable of the AP-initial content word, i.e. the syllable with the secondary stress. The ip has a phrasal tone (H- or L-) which is not associated with any particular syllable, and the IP is marked by a final boundary tone (L% or H%) and relatively large phrase-final lengthening and optionally a pause.⁹ In line with the approach taken by Pierrehumbert (1980), Jun and Fougeron assume that the phonetic realisation of the intonation contour is directly derived from the phonological representation, leading to a model with two levels of representation. At the phonological level, the tonal specifications of the AP (LHiLH*), the ip (L- or H-) and the IP (L% or H%) are specified, which are aligned with the text and implemented as a fundamental frequency contour at the phonetic level of representation. If a phonological tone fails to surface as a phonetic target (e.g. LHiLH* surfaces as LLH), this is accounted for by means of phonetic undershoot.

The main differences between this account and ours, which will be presented in Chapter 6, are the following.

- Jun and Fougeron distinguish between word-initial and word-final pitch movements (Hi versus H*); both are pitch accents in the present proposal.
- The tonal specification of the AP, LHiLH*, would appear to imply that all four tones belong to the same tonal morpheme. No such implication exists in our treatment, where the tone string is assembled from boundary tones, pitch accents and an L-tone, and the length of the tone string depends on the number of accents.
- In Jun and Fougeron's model, the tones of the phonological specification are often unrealised. In the account proposed here, all phonological tones are phonetically implemented.
- Jun and Fougeron adopt an Intermediate Phrase with its tonal specification L- or H-, which is absent in the present account.

These differences will be discussed in Chapter 6, where it will be argued that Jun and Fougeron's description cannot capture all phonological contrasts in French, and that the tonal specifications of the contours are sometimes unnecessarily complex (Section 6.4.1).

2.2.2. Di Cristo and Hirst

Di Cristo and Hirst assume that a three-layered prosodic structure mediates between the tonal and the segmental structures (Hirst and Di Cristo 1984; Di Cristo and Hirst 1993, 1996, 1997). This is exemplified in Figure 11 (adapted from Di Cristo et al. to appear). The lowest level of the Tonal Unit (TU; 3 in the figure) is delimited by an L tone at its left edge and an H tone at its right edge. Thus, each pitch movement has its own prosodic domain (i.e. one on *un jo-* and another on *-li bateau*), which domain does not necessarily coincide with word boundaries.

⁹ The tonal specification of the initial ip and IP boundaries are not discussed.

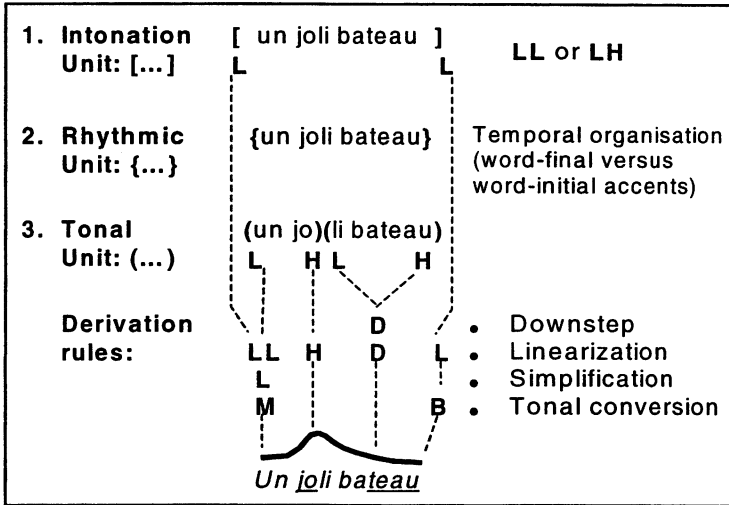


Figure 11: Illustration of Di Cristo and Hirst's three-layered prosodic structure.

An alternative pronunciation with a pitch peak on *-li* instead of *jo-* is also possible. In this case, the first TU spans *un joli*, and the second *bateau*, and they coincide with word boundaries. At the intermediate level of the Rhythmic Unit (RU; 2 in the figure), differences in metrical strength are specified. They are implemented as differences in lengthening and do not affect the tonal structure. Each word-final pitch accent projects its own RU from right to left, including any preceding word-initial pitch accents in the same RU (Di Cristo and Hirst 1997). Thus, the two Tonal Units in *un joli bateau* in Figure 11 together form a Rhythmic Unit, and since the accented syllable *-teau* coincides with the boundary of the RU, it will have a longer duration.¹⁰ At the highest level, Tonal Units are organised into Intonation Units (IU; 1 in the figure), which are delimited by an LH or an LL tone sequence associated with their left and right edges, respectively. Thus, the L and H tones of the IU are comparable to the IP-initial and -final boundary tones of the other descriptions. A fourth unit is identified, somewhat comparable to Jun and Fougeron's Intermediate Phrase, called *Segment d'UI* 'segment of IU' (not given in the figure). The *Segment d'UI* occurs in unfinished or interrupted utterances, or in extraposed sequences such as the underlined part in *Ça lui ferait plaisir, une bonne bouteille de champagne* (Di Cristo and Hirst 1996). The *Segment d'UI* in this example is characterised by low or high level pitch. Instead of forming an IU with its own LL or LH specification, the *Segment d'UI* copies the final tone of the preceding phrase *Ça lui ferait plaisir* (cf. Gussenhoven 1988).

¹⁰ The Rhythmic Unit in Figure 11 coincides with the Intonation Unit, but Intonation Units can contain more than one Rhythmic Unit.

The tones of the TU and IU are defined at the underlying level of the phonological representation, and transformed into a phonological surface form (MHDB in Figure 11) by means of a set of phonological rules. Thus, Di Cristo and colleagues distinguish two phonological levels (cf. Gussenhoven 1984, 1985). In addition, they distinguish a phonetic from a physical level of representation. At the phonetic level, the tones of the phonological surface representation (referred to as autosegments) are interpreted as a 'modelled' contour, which in turn is implemented in terms of fundamental frequency at the physical level (not presented in the figure; Di Cristo and Hirst 1996).

The most important differences between the account of Di Cristo and colleagues and ours are the following.

- The Tonal Unit is the minimal unit of tonal description in Di Cristo's and Hirst's account; its equivalent in the present analysis is probably the accented syllable, with which the (H+)H* pitch accent associates.
- Di Cristo and Hirst adopt the *Segment d'UI* to account for intonation contours involving dislocated constituents; there is no equivalent in the present analysis.
- Instead of Di Cristo and Hirst's four levels of representation, the present account only has two.

In Chapter 6, it will be argued that the transformation between the phonological levels in Di Cristo and Hirst's account leads to some confusion about, for instance, the categorical or gradient nature of tonal differences (Section 6.4.2).

2.3. Reformulation of the research questions

The research questions of Chapter 1 can now be reformulated as follows:

- I. Which pitch movements occur around stressed syllables and boundaries?
- II. Which differences between pitch movements are categorical?
- III. What is the inventory of pitch accents and boundary tones?
- IV. Which positions in the prosodic structure do they associate with?

Hypotheses about gradient and categorical variations in pitch around stressed syllables and boundaries were drawn up on the basis of an auditory and acoustic analysis of two speech corpora, reported in Chapter 5. The third question is addressed in Chapter 6, where a tonal analysis with two pitch accents (H* and H+H*), five boundary specifications (%L, %H and L%, H%, 0%) and an optional L-tone is claimed to account for all and only the categorical differences identified in Chapter 5. Chapter 7 returns to the first two questions, as it investigates some predictions of our tonal analysis about categorical and gradient variation. The fourth question can in part be answered here. As was mentioned in the previous section, we assume that the Intonation Phrase is the domain of association of the boundary tone. The boundaries of Intonation Phrases are usually recognisable by the completion of a phonologically distinct pitch movement (internal criteria), the occurrence of a pause, final syllable lengthening, a drop in amplitude, and resetting of the register (external criteria; e.g. Vaissière 1983). Since the concept of the Intonation Phrase is relatively

uncontroversial in French, the issue of the mapping between Intonation Phrases and other levels of the grammatical structure will not be pursued in this study.¹¹ However, conflicting claims have been made about the structure(s) relevant to the association of the pitch accents, as was pointed out in Chapter 1. Therefore, the formal definition of the domain which has been claimed to condition the distribution of pitch accents in French will be empirically investigated in Chapter 3, and the interaction between phrasing and pitch accent assignment will be described in a constraint-based analysis in Chapter 4.

¹¹ Boundaries of prosodic constituents below the Intonation Phrase have also been claimed to associate with a tone in French (Intermediate Phrase in Jun and Fougeron 1995, to appear, and the *Segment d'UI* in Di Cristo and Hirst 1996). In Chapter 6 section 6.4, it will be argued that this is not necessary.

Chapter 3 Pitch accents, Liaison and the Phonological Phrase: An experimental investigation

Recent treatments of French intonation claim that the Phonological Phrase accounts for the distribution of pitch accents, by which the pitch accent at the right edge of the Phonological Phrase is obligatory and other pitch accents are optional.¹ The investigation presented in this chapter is primarily concerned with the question whether the prosodic domain that conditions this distribution of pitch accents can be defined on independent grounds. It has been claimed that the segmental process of Liaison motivates the existence of the Phonological Phrase in French, while more recently, the tonal phenomenon of Clash Resolution has also been advanced as being conditioned by the Phonological Phrase (Section 3.1). A production experiment was designed to investigate the application of Liaison and Clash Resolution (Section 3.2). The findings, reported in Section 3.3, call the claim that Liaison is bounded by the Phonological Phrase into question. The domain of application of Clash Resolution, by contrast, is the Phonological Phrase. Section 3.4 concludes this first part of the investigation.

The second part of this chapter addresses two questions that arose during the analysis of the data (Section 3.5). The first question concerns the optional restructuring of two Phonological Phrases as a single Phonological Phrase, which is assumed to account for cases in which the application of Clash Resolution is optional. Although the experiment confirmed the correlation between phonological phrasing and Clash Resolution, some of the Clash Resolution cases were found to conflict with the rules for the restructuring that have been proposed in the literature. Thus, it was no longer clear how optional restructuring of Phonological Phrases is governed by the syntactic structure. The question was, therefore, whether these cases can be accounted for on the basis of a revised definition of restructuring.

The second question concerns the nature of the phonological rule. In line with earlier accounts of the Rhythm Rule in English, French Clash Resolution has so far been described as a shift of the first accent to an earlier syllable in the word (Verluyten 1982; Hoskins 1994; Mazzola 1994). However, the data presented in this chapter strongly favour the view defended by Bolinger (1981), Gussenhoven (1987, 1991a) and Shattuck-Hufnagel (1991) for English that the process involves the deletion of the word-final pitch accent. Additional acoustic measurements were taken in the fundamental frequency traces of the production data which were compared with the perceptual judgements.

¹ The part of this chapter concerned with restructuring and the phonological description of Clash Resolution has been published in *Linguistics* 37 (1999); the investigation reported in Sections 3.1 to 3.4 and the provisional account of Liaison proposed in Section 3.7 will appear in *Probus* 11 (2000).

The implications of these findings will be discussed in Section 3.6. In Section 3.7, a provisional suggestion for the account of Liaison is presented, in which the process has a syntactically defined domain of application, and is to be accounted for with the help of a lexical insertion process that takes precompiled forms from the lexicon.

3.1. Introduction

Traditionally, descriptions of French intonation assume that the prosodic domain that receives the full intonation contour in an utterance contains a sequence of Rhythmic Groups (Grammont 1966; Coustenoble and Armstrong 1934; Fouché and Dauzat 1935; Delatré 1966b; Ashby 1975). These lower level domains are claimed to account for the distribution of pitch accents. More specifically, at the level of the Rhythmic Group, some locations obligatorily receive a pitch accent, whereas other pitch accents are optional. In French, the rightmost full syllable of the lexical word is stressed and is a potential location for a pitch accent. The distribution of the pitch accents is given by the rule that only the pitch accent at the right edge of the Rhythmic Group is obligatory. In (1), the locations of the pitch accents are indicated by asterisks. The two Rhythmic Groups (RG) both receive an obligatory domain-final pitch accent; the first Rhythmic Group optionally has a second pitch accent on *petit* (given in brackets):²

- (1) (*de petits enfants*)RG (*intelligents*)RG ‘small intelligent children’
 (*) * * *

The Rhythmic Group has never been formally defined. Thus, no unequivocal way of decomposing an utterance into Rhythmic Groups has been put forward. However, in more recent treatments, the Rhythmic Group has been claimed to correspond to the Phonological Phrase (Verluyten 1982; Delais 1994), which has received a formal definition in the theory of Prosodic Phonology (Selkirk 1984; Nespor and Vogel 1986): the Phonological Phrase is a constituent of the Prosodic Hierarchy which is positioned between the Intonational Phrase and the Prosodic Word. As can be seen in (2) (based on Nespor and Vogel 1982: 228), the Phonological Phrase is derived from the syntactic constituent structure.³

(2) **Phonological Phrase formation rule**

A Phonological Phrase groups together a lexical head (X) with all the items on its non-recursive side (i.e. the left) within the maximal projection and with any other non-lexical item on the same side

² Additional word-initial pitch accents, optional on *in-* in this example, will be discussed in Chapter 4.

³ Nespor and Vogel's relation-based approach to the mapping between the prosodic and syntactic structure is presented here, as this is the view which has been adopted by Verluyten and Hoskins in their treatment of French Clash Resolution (Section 3.1.1). Selkirk's end-based approach makes the same predictions about the domain of obligatory resolution of clashes, which would be the Small Phonological Phrase in Selkirk's account (1986, 1995).

The application of the Phonological Phrase formation rule is exemplified in (3), where the two lexical heads are marked by a square bracket (PP stands for Phonological Phrase).

$$(3) \quad \begin{array}{ccc} &]X^{\text{head}} &]X^{\text{head}} \\ (de \textit{petits enfants})PP & (intelligents)PP & \\ (*) & * & * \end{array}$$

In (3), each head forms a Phonological Phrase with all the material that precedes it. French pre-nominal adjectives cannot function as the heads of Phonological Phrases, and therefore *petits* in (3) does not form a Phonological Phrase on its own (Verluyten 1982; Nespor and Vogel 1986; Selkirk 1986). The rule for the distribution of pitch accents in the Rhythmic Group can now be reformulated by referring to the Phonological Phrase.

The central question addressed in this chapter is whether a motivation for the Phonological Phrase can be found which is independent of the rule for pitch accent distribution illustrated in (3). Two phonological processes have been claimed to operate within the Phonological Phrase.

Firstly, in common with English and German (Giegerich 1985) and many other languages, French has a specific accentual configuration that arises in stress clash contexts, which will be referred to as Clash Resolution (Garde 1968; Verluyten 1982; Dell 1984; Hoskins 1994; Mazzola 1994; Delais 1995). Clash Resolution is here interpreted as one of the factors that determine the distribution of pitch accents. Clash Resolution would be a strong diagnostic for Phonological Phrase structure. As will become clear in Section 3.1.1, Clash Resolution and the rule for pitch accent distribution illustrated in (3) occur in complementary contexts. Example (3) shows that the absence of a word-final accent signals the absence of a Phonological Phrase boundary, but the presence of a word-final accent does not necessarily entail the presence of a Phonological Phrase boundary, because lexical words that do not occur in Phonological Phrase final position can also have a word-final accent. Therefore, the 'default' distributional pattern of pitch accents illustrated in (3) is only a weak diagnostic for Phonological Phrase structure. By contrast, Clash Resolution would provide a strong diagnostic in those cases in which the stress clash context is present: if it applies, the prosodic structure must be such as to include that context in one Phonological Phrase, while if it does not, it must be distributed over two Phonological Phrases.

Secondly, the application of Liaison has been assumed to be conditioned by the Phonological Phrase (Verluyten 1982; Nespor and Vogel 1982; Booij 1986; Selkirk 1986; Booij and de Jong 1987; De Jong 1994). In fact, the domain relevant to the distribution of accents in French has been directly linked with the domain of application of Liaison (Pulgram 1965; Ashby 1975; Léon 1992), and Verluyten (1982) explicitly asserts that both Clash Resolution and Liaison are bounded by the Phonological Phrase.⁴

⁴ However, adopting Martin's model of French intonation (1978), Morin and Kaye (1982) found that Phonological Words defined in terms of intonation patterns cannot be equated with the domain of Liaison.

Although several corpus studies have revealed cases that seem to be incompatible with this view (Ågren 1973; Morin and Kaye 1982; Encrevé 1988; De Jong 1994), the claim that Liaison provides evidence for the Phonological Phrase as a constituent of the Prosodic Hierarchy has evidently not disappeared from the literature.⁵

In this chapter we intend, first, to provide independent phonetic evidence for Phonological Phrase structure. This evidence will be used to decide if either or both of the two processes at issue, Clash Resolution and Liaison, apply within the Phonological Phrase. Second, if the Phonological Phrase conditioning of at least one of these processes is confirmed, we intend to check whether the definition of the Phonological Phrase as given in (2) is empirically adequate. Obviously, if both processes are found to behave in the same way, and in conformity with the phonetic data, this finding will provide evidence for the Phonological Phrase as a prosodic constituent in French. However, if only one of them behaves in conformity with the phonetic data, the other process must be conditioned by other factors.⁶ Finally, if one or both processes apply within the Phonological Phrase as defined by the independent phonetic data, and the description in (2) fails to capture this domain, that description will need to be revised. We will not contemplate the consequences of any further types of incongruities.

A production experiment was designed to investigate the Phonological Phrase conditioning of Liaison and Clash Resolution (sections 3.2 and 3.3). The occurrence of Clash Resolution was established on the basis of the judgements of three trained phoneticians who were native speakers of French and the application of Liaison was established auditorily. In order to have independent evidence for the Phonological Phrase structure, vowel durations in the syllable before the monosyllabic word were measured. An analysis of the durations measured in the experimental conditions and a baseline control condition confirmed that in our experiment, pre-final durations for words that were followed by a Phonological Phrase boundary were significantly longer than those for words that are located Phonological Phrase internally (discussed in sections 3.2.1 and 3.2.3.1). The findings for Clash Resolution strongly support the claim that the distribution of pitch accents is sensitive to the Phonological Phrase as defined in the literature. However, the results show that Liaison is very unlikely to be conditioned by the Phonological Phrase. This means that Liaison cannot provide corroborating evidence for the Phonological Phrase as a prosodic constituent in French. The implications of these findings will be discussed in Section 3.4.

The following introductory sections present the claims that have been made in the literature that motivated the production experiment. Sections 3.1.1 and 3.1.2 discuss Clash Resolution and Liaison, respectively. The final section provides a summary statement of the ensuing predictions about the application of the two processes in the Phonological Phrase.

⁵ In their article, Morin and Kaye (1982) challenged Selkirk's proposal to analyse Liaison as a deletion process that depends on the presence of word boundaries, which are defined by syntactic structure. It should be noted that this account of Liaison was not formulated in the framework of Prosodic Phonology.

⁶ The possible assumption that one of the rules is bounded by a domain at a different level of the prosodic hierarchy would be void: if a process applies at a higher level of the prosodic hierarchy, it should also apply at the lower level of the Phonological Phrase, and if either rule were confined to the Prosodic Word, there would be no context for it to apply in.

3.1.1. Clash Resolution

French has a specific accentual configuration that arises in clash contexts, here referred to as Clash Resolution (Verluyten 1982; Mazzola 1993, 1994; Hoskins 1994).⁷ Clash Resolution is similar to the Rhythm Rule in English and German and many other languages, a process which is also referred to as Stress Shift or Iambic Reversal (cf. Giegerich 1985). Clash is defined as the occurrence of adjacent word stresses. An example is given in (4).

(4) <u>Clash context:</u> Japanese tables * *	→	<u>Rhythm Rule:</u> Japanese tables * *	
<u>Clash context:</u> <i>de jolis airs</i> * *	→	<u>Clash Resolution:</u> <i>de jolis airs</i> * *	‘pretty tunes’

In cases such as *de jolis airs* in (4), where a polysyllabic lexical word is followed by a monosyllabic lexical word within a Phonological Phrase, it is assumed that the phonological rule of Clash Resolution obligatorily applies to relieve the clash.⁸

Analogous to the approaches to stress shift in English, three accounts of the pattern given in (4) can be proposed for French. In a pitch accent based account, the pattern would result from a process that affects phrase level pitch accent placement (Bolinger 1981; Gussenhoven 1987, 1991a; Shattuck-Hufnagel 1991). In Gussenhoven’s view, the apparent stress shift underlying the English Rhythm Rule results from the deletion of the final accent of the stress shift candidate, causing the initial pitch accent, which is independently present on the secondary stressed syllable before the primary stress, to stand out as the more prominent one. In a rhythm-based account, clashes are assumed to arise between rhythmically strong syllables whose relative prominence is represented in terms of a metrical grid. Such clashes result in a shift of the stress to an earlier syllable in the stress shift item (Liberman and Prince 1977; Hayes 1984). An alternative view is that the stress on the final syllable of the stress shift item is reduced, with the strengthening of another syllable being optional (Prince 1983; Selkirk 1984; Nespor and Vogel 1989; Vogel et al. 1995). For French, accentual patterns as in (4) have been claimed to result from a shift of the prominence (Verluyten 1982; Hoskins 1994; Mazzola 1994). Although the results from a pilot study reported in Hoskins (1994) suggest that there is a preference for two-accent patterns in clash contexts, it is not clear whether the presence of an initial accent on the stress shift item is obligatory (Verluyten

⁷ Mazzola (1993, 1994) describes Clash Resolution with reference to compounds and noun phrases exclusively, but does not mention the Phonological Phrase.

⁸ Clashes can also arise within Phonological Phrases between (a) a word-final and a word-initial stress, as in *un grand événement* ‘a big event’, or between (b) two word-final stresses, as in *un grand bal* ‘a big ball’. It seems that in such cases, the clash cannot be resolved unless one of the accents is not realised. Possibly, this process should be distinguished from the one illustrated in (4), and we will therefore not consider such clash contexts in the present investigation.

1982; Dell 1984).⁹ Fortunately the issue whether Clash Resolution involves the realisation of an initial pitch accent does not affect the assumption that the process is bounded by the Phonological Phrase. It is only the absence of the word-final accent on the stress shift item which is crucial to that assumption.

In addition to the obligatory application of Clash Resolution within Phonological Phrases, the process is claimed to apply optionally in phrases such as (5), in which the Phonological Phrase formation rule given in (2) predicts a Phonological Phrase boundary between the lexical heads. Note that in the usual pronunciation, *sages* is monosyllabic /saʒ/.

- (5)]X^{head}]X^{head}
 des enfants *sages* ‘well-behaved children’
 * *

Verluyten (1982), basing himself on Nespor and Vogel (1980), accounts for such cases by assuming that French Phonological Phrases can optionally be restructured, a claim which Hoskins (1994) reiterates with some reservation.¹⁰ In general, restructuring has been proposed in order to account for phonological rules whose domain of application broadens under certain circumstances (e.g. *Raddoppiamento Syntattico* in Italian, Nespor and Vogel 1982, 1986; restructuring can capture the fact that the length of certain phonological constituents is relevant to the application of a phonological rule). Thus, the optionality of such rules is not a property of the rule itself, but of the restructuring of the phonological constituent (Nespor and Vogel 1986:172). The restructuring of Phonological Phrases is rigorously conditioned. Nespor and Vogel (1982:230) give a language-independent formulation of these conditions, here reproduced as (6).

(6) **Phonological Phrase restructuring rule**

A non-branching Phonological Phrase which is the first complement of X on its recursive side loses its label and is joined to the Phonological Phrase containing X under a new node labelled PP’

Since in French the recursive side is the right, *sages* in (5) is a candidate for restructuring with the preceding lexical head *enfants*. Restructuring can take place, because *sages* is the first complement of *enfants* and does not branch.¹¹ In (7a), the

⁹ In fact, the data presented in Section 3.5 show that in a relatively small number of cases, only the second pitch accent is realised, which conflicts with the shift-account of the French literature. Although Verluyten also adopts this view, he observes that in some variants of French, the initial accent can be suppressed altogether (Verluyten 1982:89).

¹⁰ The introduction of the restructured Phonological Phrase in French echoes similar proposals made to account for accentual patterns that were not formulated within the framework of Prosodic Phonology (Ashby 1975; Rossi 1985; Martin 1987; Mertens 1993b). Mazzola (1994) states that Clash Resolution is optional in Noun-Adjective sequences, but does not formalise his observations in the framework of Prosodic Phonology. Ashby (1975) also refers to the minor and the major Rhythmic Group to account for the variability in the application of Liaison.

¹¹ Verluyten (1982: 390) argues that Nespor and Vogel’s non-branching complement ‘n’est rien d’autre qu’un