FOR A DEPENDENCY THEORY OF INTONATION

David Le Gac[a] *& Hi-Yon Yoo*[b]

[a]DYALANG, CNRS FRE 2787, Rouen Univ. ; [b]EA 333, Linguistic Department, Paris 7 Univ.
david.le.gac@wanadoo.fr ; yoo@linguist.jussieu.fr

ABSTRACT

This paper presents a theory of intonation for French. It discusses morphological approaches where tones or contours are derived by meaning. We propose an intonational structure independent from other components of the grammar, where the phonological units are interrelated by dependency rules.

Keywords: French, intonation, dependency, Focus

1. INTRODUCTION

Most theories of intonation (cf. [6], or [8]) commonly admit that phonological units such as tones or contours are put into a string to form melodic configurations that constitute the intonation of an utterance. These units are viewed as independent local events having no relation to each other. Thus, all combinations of these units are *a priori* considered as well-formed.

In these frameworks, the choice between different tones or contours is determined not by a phonological device, but by the meaning we attribute to each intonational unit, which explains why such theories may be considered 'morphological': a given contour or tone is necessarily associated with a given meaning (Ladd [4]). In other words, the speaker chooses between the various intonational units with respect to the meaning he wants to convey (e.g.[7] or [8]).

The aim of this paper is twofold. In section 2, we present the results of French data where two main components of meaning, information structure and illocutionary force were systematically varied. We argue that a morphological approach to intonation cannot properly account for melodic patterns found in French.

We show that there is not a one to one relationship between meaning and intonational units: one meaning can correspond to several tones while the latter tones can be attributed other different meanings. In fact, data suggest that the various tonal patterns depend on their location relative to the Focus.

These observations lead to the need for an intonational structure, independent from other linguistic components including meaning. Intonation should not be represented as a string of mere independent units associated with a specific meaning but rather as a structure where the minimal units, tones, are interrelated.

We present this intonational structure, inspired by Martin's works [5] in section 2: we postulate a root tone that maintains dependency relations with the other tones of the utterance. These dependency relations limit the different possible tonal combinations by tone selection rules and, contrary to morphological approaches, all tonal combinations are henceforth not possible, since they are predictable by phonological rules.

2. DATA ANALYSIS

2.1. Corpus and methodology

The first step of this study was to establish the tonal patterns that can be obtained for utterances with different discourse organization.

We built a set of utterances where the parameters of illocutionary force (mainly interrogation and declaration) and information structure were systematically varied. In a nutshell, we adapt Vallduví's framework [9] and we use the terminology of Topic, Focus and Tail, where Focus stands for the expressed new or unexpected information while Topic indicates to which unit the focal information is anchored and Tail binds the Focus to its Topic. The corpus is composed of examples with single and multiple Foci. The single Focus may be preceded by one or two Topics, and followed by one or two Tails. Finally, the different informational units consisted of a simple NP ("Valérie") or extended NPs ("L'ami de Valérie"). See Table 1 for some examples.

French native speakers were asked to read as naturally as possible and without any particular emotion a set of isolated utterances. For each utterance, a context question helped the speaker to add the appropriate intonation corresponding to the

tested information structure. Only fundamental frequency (F_0) was examined in this study.

Table 1: Some examples of our corpus data: F, T and t mark respectively the utterance's focus, topic and tail.

Single Focus Constructions	[Vendredi]T [chez Noémie]T [c'est Valérie]F [qui a mordu Amélie]t [Friday]T [*at Noémie's*]T [*it's Valerie*]F [*who bit Amélie*]t
Multiple Topic-Focus constructions	[Valérie]T elle a eu [la Ferrari]F [Noémie]T [la librairie]F et [Amélie]T [la boulangerie]F [*Valérie*]T she got [*the Ferrari*]F, [*Noémie*]T [*the library*]F and [*Amélie*]T [the bakery]F

2.2. Results and discussion

We will begin with single Focus constructions. The tonal height is informally described in this subsection with a descending scale H+>H>L>L⁻ used as exponents on the corresponding syllables. The accented syllables are in capital letters.

Image file 1 and sound file 1 is an example of declarative constructions. Whether the Focus is a simple NP or not, we observe that the last syllable of the Focus is marked by a low tone that generally reaches the low end of the speaker's pitch range. The difference between simple and extended NPs is the location of the high tone: a simple NP always bears a High tone normally at the beginning of the focal unit, (giving patterns such as (^{H}valéRIE^{L-})), while in an extended NP, the high tone falls on the last syllable of the first noun (^{L}aMI^{H}). In an extended NP, the succession of the two H tones may form a 'hat' pattern. Our data are in accordance with results reported by [1], [3], [5] and [8] among others.

Interrogative utterances (Image file 2 and sound file 2) show an inverted pattern, with an extra high tone on the final syllable which is always preceded by a low tone in simple NPs (^{L}valéRIE^{H+}). The same pattern is also found in extended NPs with a slight F_0 rising on the first syllable of *"ami"* (^{L}c'est ^{H}l'aMI^{L} de ^{L}valéRIE^{H+}).

We observe the same pattern [(LHL)LH] in Topics of declarative utterances (see [1], [3], [5], [8]). The difference is that this pattern appears without any extra high tone. As illustrated in Image file 1, the same pattern is repeated in each Topic. In some cases, several Topics combine to form a single unit, realised as a single [HLLH] pattern: (^{H}vendreDI^{L} + chez ^{L}noéMIE^{H}).

Interrogative Topics always end with a flat and rather low contour [L..L] (Image file 2 and [1], [3], [5]). We did not observe any high or mid tone on the left edge of simple NPs, contrary to extended NPs where a high tone is found on the second syllable: (^{L}l'aMI^{H} de valéRIE^{L}). This tone is followed by a falling contour (Image file 2).

The pattern observed for Tails confirms data observed by [1], [3], [5] and [8]: Tails are characterised by a low and rather flat or steadily falling F_0. However, we observe a slight F_0 rise within Tails with no particular syntactic dislocation (i.e. "qui a morDU^{H} améLIE^{L-}", see Image file 1 and [5]). In interrogative utterances, Tails are marked by iterative H($^{+}$) tones (Image file 2 and [1], [3], [5], [8]).

If we turn now to multiple Topic-Focus constructions, the informational units present totally different patterns (Image file 3). The intonational patterns seem to depend on where each informational unit occurs in the utterance rather than on meaning. The first two Topics share the same [L..L] pattern with interrogative Topics, being in rupture with the pattern of the last Topic which has a rising contour. Notice that we also find a rising contour on the first two Foci while the last Focus has a falling pattern: $[L..L]_T$ $[L..H]_F$ - $[L..L]_T$ $[L..H]_F$ - $[L..H]_T$ $[H..L^-]_F$.

In other words, data observation shows that the same rising pattern [L..H] appears on Topic, Focus or Tail; the same [L/H..L] pattern is found on a Topic or a Focus and the same [(H)L⁻] pattern on a Focus or a Tail. The [L..H^{+}] pattern is found on interrogative Focus or Tail units. These results encourage us to say that the shape of the intonational patterns does not derive directly from meaning: we are far from finding a direct correspondence between a given intonational pattern and a given meaning.

The analysed data seem to present evidence that the last Focus of a given utterance plays an essential role in the structure: not only is the contour of the Focus the only obligatory contour in the utterance, but it is also salient, meaning that it is realised in the extremes of the tonal registers. Moreover, it seems that this contour indicates illocutionary force.

In addition, it appears that the shape of the other contours depends essentially upon the final tone of this focal unit: if the latter is high, then the preceding information units are low, Focus or Topics regardless, and vice-versa. The right-hand constituents share a similar tone with this final tone of the Focus.

In multiple Focus constructions, we notice a multilevel dependency, where the tone of the final Focus selects the final tone of the preceding Foci, whereas this selected tone selects the tone attributed to the associated Topics.

All of these observations lead us to a theory of intonation that takes into account the dependency

relationships between minimal units. The model is presented in the next section.

3. THE INTONATIONAL STRUCTURE

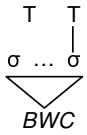
3.1. Intonational primitives

Following other frameworks ([1], [4] and [6]), we claim that the phonological tones High (H) and Low (L) are sufficient to account for French intonation. H and L are the phonological primitives of the intonational structure.

However, contrary to the above-mentioned frameworks where tones are linked to the segmental chain via prosodic constituents, such as accentual or intonational phrases, we argue that tones organise themselves into an independent intonational structure governed only by relations of dependency between each other. These relations make possible the derivation of the different tonal patterns and their phonetic realisation observed in French.

We call the minimal segmental unit which the primitives are attached to the Basic Word Chunk ("BWC"): a BWC (Figure 1) is composed of at least a lexical word and the surrounding clitic words. We claim that each BWC is assigned a pair of tones that are interrelated by the following dependency relation: an obligatory tone at the right edge of the BWC and an optional initial tone. This initial tone is a floating tone preferentially realised at the BWC's left edge. The optional status of this floating tone is easily accounted for by the dependency relations, which we will show in subsection 3.3.

Figure 1: an obligatory tone at the right edge of the Basic Word Chunk (BWC) and an initial optional floating tone



3.2. Root-tone and interface with meaning

Our main claim is that intonational structure is independent from other linguistic components and therefore also from meaning. We postulate that the tones of a given utterance are derived from a *starting root tone* ("T_0") which is the last tone found on the focalized unit: this T_0 is obligatory and sufficient to form a well-formed utterance whereas all other tones may appear only if the latter is realised.

This root tone is also essential because it is the original link with a wider "semantic structure" including illocutionary force and informational structure ([9]) where the Focus is the central and obligatory element. The interface between intonation and meaning is established between this Focus unit and T_0. In other words, only the root tone is linguistically motivated, its nature being determined by the illocutionary force of the utterance, where interrogation associates a high tone and declaration, a low tone.

We postulate that the root tone T_0 associates with the last syllable of the Focus unit. T_0 directly governs the right-edge tones of the other informational units of the utterance. Consequently, a single root tone and a small number of tone selection rules are sufficient to compute all of the other tones of the utterance which are entirely predictable on formal grounds only.

3.3. Tonal selection rules

The tonal selection rules presented in this subsection rely on the two following basic relationships:

- **"Precedence":** A tone T_b is said to precede a tone T_a if and only if T_b is to the left of T_a.
- **"Government"**: A tone T_a is said to govern a tone T_b if and only if the presence of T_a is a necessary condition for T_b. T_a is called the head tone, while T_b the dependent tone.

The government relation establishes a hierarchy among tones: by convention, we call T_1 (H_1 or L_1) all tones that depend on the root tone T_0 (H_0 or L_0), T_2 (H_2 or L_2) all tones that depend on a T_1 and T_3 (H_3 or L_3), all tones that depend on a T_2.

According to these two relationships, we postulate the two following tone selection rules for French.

- **"Tone Copy Rule" (TCR):** Government to the *right* selects the same tone for the dependent tone as the head tone.
- **"Tone inversion rule" (TIR):** Government to the *left* selects the *opposite* tone to the head tone.

These two rules and the tonal hierarchy accurately generate all tones of a given utterance, as shown in the next subsection.

3.4. Tonal derivation

Let us begin with single Focus constructions. Image file 4 gives an example of a complete intonational structure for this type of construction: the root tone T_0 selects a T_1 tone on the right edge of each Topic and of the other Focus of the utterance by applying the Tone Inversion Rule (a L_1 is selected when T_0 is H_0

and an H_1 when T_0 is L_0). On the other hand, the Tone Copy Rule implies that if T_0 is H_0, then the following tone will be H_1; conversely, if T_0 is L_0, then the following tone will be L_1.

Furthermore, the same TIR applies within the BWC deriving thus the floating left-hand tones that are governed by the right-edge tone (see subsection 3.1.). The TIR applies within a BWC as follows: the right-edge tone inverts the initial tone. We therefore correctly derive the observed patterns within all BWCs. In particular, in a focalised BWC, if the right-edge tone realised as the root tone T_0 is L_0 (i.e. in declarative utterances), an H_1 tone is selected by the TIR for the floating initial tone. The tones are inverted in an interrogative utterance, which explains why there is never an initial high tone in simple NPs.

In addition to that, tonal hierarchy allows for capturing the optional or obligatory status of the tones of the complete structure by applying the following rule:

- **"Optionality Rule" (OptionR):** T_1 tones are always obligatory whereas lower tones (T_2, T_3) are optional when they do not govern another tone.

This rule account for why right edge tones are obligatory: thus, though floating, the initial tone of the Focus is always realised, as opposed to other floating tones of the structure.

When an informational unit is realised by two BWCs, the intonational structure is as follows: all tones undergo tonal inversion, first between the right edge tones of each BWC, but also *within* the BWCs, as shown in Image file 4. According to the OptionR given above, T_2 and T_3 tones (marked as circled tone in Image file 5) are optional, which our data support. Moreover, the tonal hierarchy corresponds with the actual phonetic output of high tones when realised: an H_1 tone is normally higher than an H_2 or H_3 tone.

Image file 5 shows easily why it is possible to see hat patterns in constructions with complex NPs. We see that the association of the TIR and the tonal structure of a BWC mechanically generate an H_1-H_1 sequence on the Focus that is composed by more than one BWC.

These same rules can easily account for the tonal patterns of multiple Foci and Topic constructions (example given in Image file 3). We argue that in these constructions, the root tone T_0 is assigned to the right-edge of the final focal unit. The right-edge tones of non final Foci depend phonologically on T_0 and are derived by the TIR since it is a right-hand dependency. This procedure allows for the establishment of a relationship between the Foci of one utterance, possibly revealing different semantic values for each Focus. The same TIR is applied to each Topic, where the tone borne by the Focus assigns an inverted tone to its corresponding Topic.

For instance, the final Topic "améLIE" and the Foci "la ferraRI" and "la libraiRIE" are on the same tonal level and share the same tone H_1: they all derive from the final root tone L_0. On the other hand, the final tone on the Topics ("valéRIE" and "noéMIE") is at a lower level in the structure (i.e. L_2) since it is derived from the H_1 tone associated with the right hand Focus (Image file 6).

The intonational structure undergoes a phonetic adjustment rule, where a default low tone is inserted on each atonic syllable. We thus obtain a final structure that can be easily implemented for the phonetic output.

4. CONCLUDING REMARKS

The intonational structure presented in this paper can account for the tonal patterns of French through simple dependency rules and without relying on semantics. We have shown that a single root tone and a small number of tone selection rules suffice to predict all of the other tones of an utterance on formal grounds only. We believe this theory can be applied to a wide range of tonal constructions, and also to other languages than French.

5. REFERENCES

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