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IS INTONATIONAL MEANING COMPOSITIONAL?[1]

Cristel PORTES
Université d'Aix-Marseille & LPL (UMR 7309)

Claire BEYSSADE
Université Paris 8 & Institut Jean Nicod (UMR 8129)

RÉSUMÉ

Cet article s'interroge sur la contribution de l'intonation au sens d'un énoncé et plus précisément sur la possibilité de proposer une approche compositionnelle du sens des contours intonatifs. Après avoir présenté rapidement différentes positions défendues dans la littérature, et après avoir précisé si et dans quelle mesure ces propositions peuvent être dites compositionnelles, nous montrons que ce qui fait la différence entre elles peut se résumer en deux points : (i) quelle place fait-on à la phonologie ? et (ii) quelles sont les dimensions de la signification mises en jeu par l'intonation ? Il apparaît alors qu'on ne peut proposer une analyse compositionnelle du sens de l'intonation que si on abandonne l'idée d'une association directe entre formes et fonctions et qu'on élabore une proposition qui articule, tant en ce qui concerne la phonologie que la sémantique, des niveaux de représentation intermédiaires, mettant en jeu des primitives abstraites. Ce n'est qu'à ce prix qu'on peut analyser les contours et leurs sens et isoler des atomes qui associent une forme et un sens. Dans la dernière partie de l'article, nous élaborons quelques pistes pour une analyse compositionnelle du sens des contours finaux focaux en français qui repose sur deux hypothèses : d'une part qu'on peut distinguer dans les contours la contribution des accents mélodiques et celle des tons de frontière, et d'autre part que les dimensions de la signification mises en jeu par l'intonation ont à voir avec l'interaction. Notre thèse est que les contours du français indiquent le caractère consensuel ou conflictuel du contenu présenté, le degré d'engagement du locuteur sur ce contenu et le fait qu'il prenne en charge ou délègue au contraire à l'interlocuteur la validation de ce contenu.

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ABSTRACT

This paper addresses the issue of the contribution of intonation to the meaning of an utterance, and more precisely of the conditions that should be met to propose a compositional approach to the meaning of intonational contours. After presenting different positions in the literature and specifying if and how much these proposals can be said compositional, we show that their differences can be summarized in two points: (i) what is the place of phonology? (ii) what kinds of meaning are brought into play by intonation? It appears that a compositional approach to intonational meaning is possible only if one gives up the idea of a direct association between form and function and develops a proposal combining intermediate levels of representation with abstract primitives both on the phonological and on the semantic side. Then it becomes possible to analyze the contours and their meaning by defining parts having both form and meaning. The last part of the paper proposes several ideas toward a compositional analysis of the meaning of French tunes based on two hypotheses: (i) it is possible to distinguish between the contributions of pitch accents and those of boundary tones; (ii) intonational meaning is interactional. We claim that French tunes indicate the consensual or contentious aspect of the related content, the degree of speaker commitment and the way the speaker takes on the validation of the content of the utterance or delegates it to the addressee.

INTRODUCTION

The principle of compositionality, the paternity of which is generally attributed to G. Frege, states that the meaning of a complex expression is a function of the meaning of its constituent expressions and of the rules used to combine them. Several points must be clarified. First, this principle governs the interpretation of complex expressions and consequently assumes the existence of atomic expressions, which should be directly associated with a meaning. Therefore, we should first examine the atoms of the prosodic structure. Secondly, there are several ways to relate a complex expression (as a whole) to its constituents (its parts): the compositionality principle either directly relates a complex expression to its immediate constituents, or is applied to all intermediate constituents between the whole and its atomic parts. In the latter case, the compositionality concerns a complex expression and its immediate constituents, themselves concerned by the compositionality of their own constituents, and so on. The direct relation between a complex expression and its parts is called weak compositionality, while the compositionality that applies to all structural levels (from immediate constituents to atomic constituents via all intermediate constituents) is called strong compositionality. Several kinds of compositionality can therefore be distinguished. Last but not least, the way the constituents are combined is also important. It explains the difference in interpretation between the two sentences “John loves Mary” and “Mary loves John”, although they contain the same three words. Indeed, the difference in syntactic structure is reflected by the word order. The syntactic rule, which

decides of the order of a subject, a verb and an object, crucially contributes to the interpretation of the sentence. Again, the expression "the way the constituents combine" is largely underspecified and may give rise to rather different interpretations.

Specifically, the contribution of prosody to utterance meaning is elaborated very differently according to how the notion of prosodic form and the dimensions of meaning are conceptualized, and also according to how the interface between prosody and morphosyntax is conceived. Some authors claim that this interface conveys various communicative functions with more or less direct links to fine phonetic details and articulatory / acoustic parameters. These links depend on how many levels of representations are defined. On the other hand, phonological approaches to intonation assume an independent grammatical prosodic structure, which enables the elaboration of specific meanings for phonological units: it then becomes conceivable to compose these meanings during the computation of the global utterance meaning. Between these two extreme positions, different approaches variously articulate the morphosyntactic structure, prosodic form and the different meaning dimensions they convey.

Two important issues then arise: (i) how to describe intonation contours and, if they are complex entities, what are their components? (ii) what is the nature of the semantic contribution of intonation and what are the semantic primitives that are needed to describe the meaning units associated to intonation?

The first four parts of this paper propose a literature survey on the relationship between intonational meaning and compositionality, while in the last part a preliminary draft of a compositional approach of the French intonation system is proposed. Section 1 is dedicated to approaches which build a direct link between the phonetic form and some communicative functions. These approaches are the one of Xu (2005) on the one hand and the interactional approaches on the other hand. We show how and why the notion of compositionality is not well adapted to these approaches: they associate a communicative function with a set of prosodic primitives but this communicative function is not semantically analyzable. There is no one-to-one correspondence between prosodic primitives and semantic units. Section 2 shows how the issue of compositionality can make sense in constructional theories. In particular, we present Marandin's proposal (2006) which shows how to integrate melodic clichés into the whole system of French intonation contours. This system is conceived as a multiple inheritance hierarchy. Section 3 is dedicated to approaches that further elaborate compositionality by conceiving intonational contours as discrete units comparable to morphemes (the British school for English, Rossi 1999, and Delattre 1966 for French). These morphemes may also be submitted to gradual variations which themselves are meaningful (Ladd, 2008; Gussenhoven, 2004). Section 4 finally exposes highly compositional approaches to intonational meaning

initiated by Pierrehumbert and Hirschberg's proposal (1990) which relies on an analysis of the contours in tones, and its elaboration by Steedman (2007). Eventually, we explore some hypotheses towards a similar proposal for French.

This overview shows that to formulate the issue of compositionality concerning intonational meaning it is necessary to posit an abstract phonological level of representation that is distinct from the concrete realization of phonetic substance. The type of compositionality defended (weak vs. strong) then depends on the choice of the primitives, in the prosodic domain as well as in the semantic domain.

1. WEAKLY COMPOSITIONAL APPROACHES OF TUNE MEANING

It is now well established that prosody conveys various communicative functions from linguistic functions like the distinction of lexical meanings in tone languages, pragmatic functions like illocutionary moods to indexical functions like emotional moods or gender, age, geographic origin or health of the speaker. Some approaches favor very direct and poorly mediated reading of observational data and are thus quite defiant towards the concept of an abstract phonological level that would be clearly elaborated and independent. According to them, communicative functions emerge from different kinds of associations between the acoustic parameters related to prosody (i.e. fundamental frequency, intensity, duration, voice quality). Based on proposals by experimental phoneticians (Xu, 2005; but see also Cooper and Sorenson, 1981; Hirst, 2005, among others), as well as on interactional approaches, we will show that these conceptions are poorly compatible with a compositionality of prosodic meaning.

1.1. Intonation as a vector of communicative functions: the PENTA model (Xu, 2005)

The PENTA model proposed by Xu (2005) is a brilliant version of a position conceiving intonation as a vector of "communicative functions". Xu proposes that the communicative functions conveyed by prosody control, simultaneously and in parallel, the articulatory parameters that are responsible for the production of speech melody. Each function (such as lexical contrast in tone languages, information structure, phrasing, etc.) is associated with an encoding scheme of its different values (focal or non focal for instance) which specifies the values of four melodic primitives: pitch target, pitch range, intensity (articulatory strength) and duration. For instance, the focalization of an utterance constituent in English leaves pitch targets unchanged but raises the values of the pitch register, intensity and duration of the focal constituent. Conversely, it lowers the values of post-focal constituents and leaves the values of pre-focal constituents unchanged. According to Xu, the acoustic implementation of communicative functions is

not direct in his model since encoding schemes and melodic primitives realize an abstract mediation between the functions and their implementtation. However, in such an approach, there is no abstract phonological level governed by its own rules whose components could convey some specific meaning that would be composable (for further discussion on Xu's position concerning intonational meaning, see Arvaniti, Ladd and Mennen 2006). One should argue that encoding schemes associated with communicative functions could be considered semantic composable units. But is the notion of compositionality suitable for referring to the accumulation of such heterogeneous functions as constituent boundary, accent, focus, illocutionary request, etc., on the same syllable or syllable group, the syllable being the encoding unit of parametrical variations within PENTA?

Therefore, in such an approach, the notion of compositionality appears irrelevant. The way in which the meaning on the one hand and the prosodic form on the other hand are conceptualized does not allow the meanings associated with intonation to compose with one another or with the utterance meaning.

1.2. Prosody as a "contextualization cue" in interactional approaches

The functional approach to prosodic meaning is also dominant in interactional approaches and conversation analysis. John Local (2003: 117) claims that "phonetic parameters are best treated as falling into functional clusters, irrespective of their 'prosodic' or 'segmental' characteristics, on the basis of how speakers deploy them to achieve particular interactional goals". In these approaches, prosodic variations are conceived as "contextualization cues" (Gumperz, 1982; Auer and Di Luzio, 1992) which evoke interpretation schemes supporting inferences specific to the particular context of production of the utterance. Tonal configurations of phonological approaches to intonation are not relevant here. They are replaced by clusters of prosodic but also segmental indices which all contribute to the same function.

For instance, Local (2007) proposed to distinguish between two different "so" expressions: those which maintain the speech turn or the discourse topic and those which close the speech turn. The first ones are realized with greater intensity and higher pitch range than the preceding speech material and they end with a glottal occlusion sometimes preceded by a creaky voice episode. The second ones are realized with weaker intensity and lower pitch range than what precedes, they never end with a glottal occlusion and creaky voice can happen on any part of the signal. Conversely, according to Local, intonational contours associated with "so" expressions play no role in signaling their status in turn taking.

Actually, most prosodic studies within the conversation analysis framework, even those that tried to use concepts coming from intonational phonology such as the intonation phrase or "IP" (Fox, 2001; Szczepek-Reed,

2010), do not consider these units directly and systematically contribute to conversational functions such as turn taking or turn negotiation. At best, they analyze this information as associating with convergent information coming from syntactic, semantic and pragmatic levels. Bill Wells (2010: 245) concluded that "In sum, it is hard to find robust evidence from studies of naturally occurring talk that speakers and listeners actually make use of tonal contrast to convey meanings in the way that many intonation researchers have suggested."

We offer several explanations for this lack of convergence between intonational contours and interactional functions proposed by these authors. A first explanation concerns the meaning components that are used in the interactional and conversation analysis frameworks. Indeed, not only is the meaning conceived in terms of functions but it also concerns essentially the construction and the negotiation of turn taking. Yet, it is not at all guaranteed that this very aspect of language exchange is relevant to intonation meaning. On the contrary, the results of these studies tend to show the opposite. Moreover, studies on intonational meaning in the framework of intonational phonology do not mention this function. Therefore, the lack of convergence observed between intonational contours and interactional functions is not a consequence of the lack of empirical evidence for stable meanings of tonal configurations in naturally occurring data. Rather, it is a product of the theoretical elaboration of what is relevant to meaning in these approaches, which seems inadequate to intonational tunes. A second explanation concerns the formal elaboration of the objects of the prosodic analysis. Conversation analysis elaborates its objects from the surface substance of the conversation productions: for instance, Szczepek-Reed (2010) integrated all pauses as decisive marks of her "Turn Constructional Phrases". Conversely, the intonational phonology, as a phonology, elaborates abstract objects whose phonetic implementation is not transparent. For instance, a vowel may be interrupted by a creaky voice episode without losing its identity as one abstract phonological vocalic segment (see the /o/ in "so" final of a speech turn in the example given in Local 2007 and exposed above). Likewise, an intonation phrase IP may be interrupted by a silent pause or a hesitation marker like "heu" and then continue or not, without losing its status of phonological abstract phrasing unit (see Portes and Bertrand, 2011). Here again, it is the theoretical construction of the relevant objects of the analysis (here the turn taking negotiation and the surface construction of the units) that explains the non-relevance of phonological units for interactional approaches, not the data.

Another recurrent argument of interactional approaches must be discussed here: intonational contours could not be associated with stable meanings, since these meanings should be context-dependent. We believe that context dependency does not contradict the claim that intonational meanings are specific and stable. Indeed, the meaning of lexical items also

varies depending on the context in which they occur: for instance, the word *movies* may refer to the concrete object that is projected, to the piece of art that arts critics talk about or even to the place where the projection takes place. This does not prevent linguists from assigning distinctive meanings to lexical items and should not prevent intonational phonologists from seeking the precise meanings that are associated to intonational contrasts (see Gussenhoven, 1984 for further discussion on this particular point). This does not mean that intonational meaning should be of the same nature as lexical meaning. However, there is no *a priori* reason to think that concepts like polysemy or homophony, which are used in lexical semantics to treat such issues, could not also apply to intonational meaning.

The issue of compositionality of prosodic meaning therefore appears mostly irrelevant in approaches where prosody is conceived in terms of sets of phonetic parameters associated to functional aims. The units defined in these approaches are functional units (like Turn Constructional Units or TCU) that integrate prosodic information among other pieces of information. They are not autonomous prosodic units, likely to convey specific meanings that could be composed. On the contrary, such autonomous prosodic units are assumed by all the approaches that will be reviewed in the following sections.

2. INTONATIONAL CONTOURS AS CONSTRUCTIONS

It is often claimed that construction grammars reject the principle of semantic compositionality. This is not true. Actually, construction grammars just reject a generalization of the notion of syntactic transparency, according to which all elements of content in the sentence meaning should come from the words that make it up. In such a case, syntactic rules should only constrain the combination of words in phrases and clauses. Conversely, construction grammars assume that syntactic rules are directly associated with usage conditions and interpretation conditions. Consequently, the meaning of a sentence does not come only from the words that make it up but also from specific syntactic structures (constructions) which themselves convey semantic contents. In French, for example, the conditional construction without consequent, illustrated in (1) below, expresses a suggestion. This is also the case of Austinian conditionals like (2), where the truth of the consequent does not depend on the truth of the antecedent, but is fully asserted.

(1) Et si on allait au cinéma ce soir ?
What about going to the cinema tonight?

(2) Si tu as soif, il y a de la bière dans le frigo.
If you are thirsty, then there is beer in the fridge.

Utterances (1) and (2) are neither idioms nor frozen constructions. On the contrary, they are productive constructions whose syntax is totally standard. Nevertheless, one could list the constraints that apply to this kind of utterances and that give rise to this kind of interpretation (the presence of the "imparfait" tense in (1) for instance). The main idea is thus that some configurations give rise to interpretations that cannot be reduced to the meaning of the words that make them up and that contents have to be directly associated with constructions. This association is represented by semantic and pragmatic features that are directly attached to different nodes of the syntactic structure.

Compositionality is possible to the extent that constructions are analyzable. Ginzburg and Sag (2000) showed how to describe the whole of English interrogatives as constructions, themselves represented as structures of typed features. They built a hierarchy of features, first separating syntactic from semantic features, then showing how these different features combine and give rise to hybrid structures, via multiple heritage mechanisms, so that one construction (a surface form) is associated with one meaning. Compositionality results from the application of the multiple heritage mechanisms that are rigorously and precisely described: hybrid types provide a tool for an explicit description of the notion of construction.

Recently, Marandin (2006) proposed to apply the construction grammar framework and its implementation as a hierarchy of features to the semantic analysis of French intonation. In doing so, he showed how to analyze stylized contours in relation with non-stylized ones. Non-stylized contours are those that are described in most inventories of French intonation, such as Di Cristo's (1999) or Post's (2000) or Mertens' (2008). Stylized contours correspond to what is called "melodic clichés" in the literature and are illustrated by Marandin by the childish expressions "nananère" or "bisque bisque rage". Marandin showed that melodic clichés are prosodic equivalents of lexico-syntactic idioms such as "casser sa pipe" or syntactic constructions (cf. Austinian conditional in (2) above).

He first analyzed the meaning of non-stylized contours building a hierarchy of contrasts depicted in Figure 1 below. Four contours: a fall, a rise, a rise-fall and a rise-fall from penultimate are associated with meanings based on two oppositions. The first opposition contrasts the fall with all three "non-falling" contours (the rise, and the two rise-falls) at the first level of the hierarchy: the fall indicates that the content is non problematic ("no anticipated revision") while the non-fallings indicate that the content could be rejected by the addressee (anticipated revision). This first contrast is coded by the feature [± revision]. The second opposition distinguishes the non-falling contours from one another by indicating which participant is concerned by the potential "revision" of the content. The rise-fall from penultimate thus indicates that the speaker considers a possible revision of

his/her own commitments while the rise-fall indicates that the addressee should revise his/her beliefs.

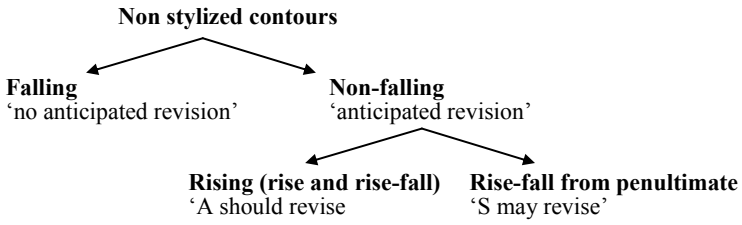

Figure 1. – Hierarchy of non-stylized contours adapted from Marandin (2006). Note that the meaning of the contrast between the rise and the rise-fall is not part of the proposal.

This semantics is identical to the one proposed in Beyssade *et al.* (2004). The originality of Marandin (2006) concerns stylized contours. Marandin (2006) proposed that each non-stylized contour has a stylized version that is a "modified basic contour with specific formal features and a regular semantic import" (Marandin, 2006: 20). The meaning of such stylized contours is explained as follows: "By using a stylized contour, the speaker presents himself/herself as playing the role of a speaker using the plain contour". Hence, the stylized contour associated to the child expression "nananère" is formally similar to the non-stylized fall from penultimate with a lengthening of the final syllable which is common to all stylized forms. Semantically, while the non-stylized form may be used to convey incredulity concerning the content of the utterance, the "nananère" contour is often used to mock the addressee by repeating one of the addressee's expression and showing how ridiculous its content is. Figure 2 below shows how non-stylized contours are related to stylized contours, inheriting directly formal and semantic properties from them.

The analysis proposed here is thus weakly compositional in that it articulates semantic components through the double opposition: [±revision] and localization of the revision (concerning the speaker or the addressee). Indeed, contours are conceived as phonological primitives that convey specific and stable meanings. This conception is shared by the phonological approaches to intonation that we will examine in the following section.

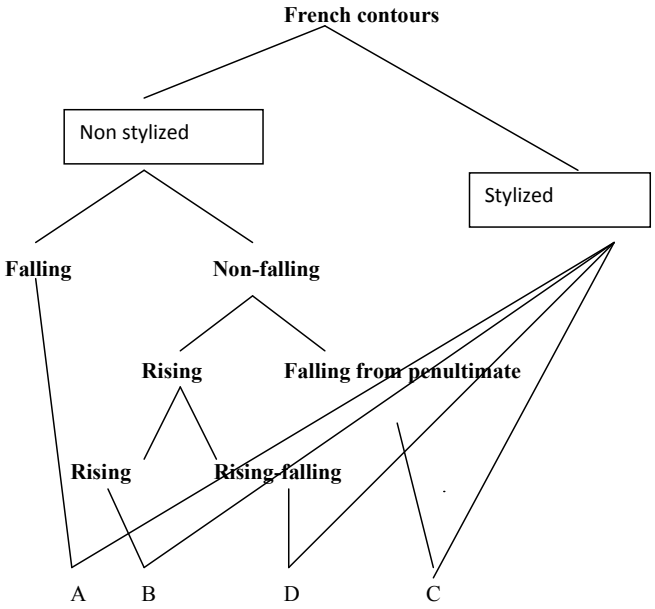

Figure 2. – Diagramm of the relationship between non-stylized and stylized contours according to Marandin (2006).

3. COMPOSITIONALITY IN PHONOLOGICAL APPROACHES TO INTONATION

Contrary to the approaches mentioned in Section 1, intonational phonology defends a conception of intonation meaning, formulated by Gussenhoven as follows: "there is, as far as I can see, no a priori reason to go on the assumption that intonational meaning is different from linguistic meaning generally" (1984: 198). Gussenhoven named this conception "Linguistic normalcy of intonational meaning" while Ladd (1996, 2008) talked about "Linguist's Theory of Intonational Meaning" whose definition is the following: "The central idea of this view is that *the elements of intonation have morpheme-like meaning*." (2008: 41, underlined by the author). The explicit comparison with morphemes makes the compositionality of intonational meanings more accessible and easier to apply in practice, since morphemes associate a form to a meaning. In the approaches that develop such a morphological conception of intonational meaning, different types of intonational morphemes and several articulations between morphemes are proposed, as illustrated in the following sections.

3.1. The contour as an intonational morpheme

The first approaches to intonation that assume linguistic normalcy are that of the British school of intonation (Crystal, 1969; Halliday, 1970; Brazil, 1997) for English, and the work by Delattre (1966) and Rossi (1999) for French.

For the authors of the British school, there is a paradigm of nuclear tones among which the speaker makes a choice during the production of an utterance. These nuclear tones are tonal configurations that may be globally falling, rising, falling-rising or rising-falling and which are anchored to the syllable bearing the main accent of the utterance (called "sentence accent"). Nuclear tones convey meanings that are added to the meaning of the whole sentence: for instance either finality or non-finality (Bolinger, 1982), or contradiction (Liberman and Sag, 1974).

For Delattre and Rossi, the global melodic schema that shapes a phrase (minor contour) or a sentence (major contour) is explicitly conceived as an intonational morpheme called 'intoneme' (Rossi, 1999) that associates its meaning to the related morphosyntactic component. For instance, in Delattre (1966) a convex rise is associated with a "major continuation" while a concave rise is associated with a "question"; a rise-fall is associated with the meaning "implication" that refers to an inferential meaning to be derived from the meaning of the sentence.

What all these approaches have in common, even though it is not explicit, is that the meaning of the nuclear tone or of the 'intoneme' is added compositionally to the meaning of the associated morphosyntactic constituent. It is especially clear for contradictions (Liberman and Sag, 1974), since the intonational morpheme is used to deny the content of the sentence to which it is associated.

Hence, the work of the pioneers of intonational phonology, in English as well as in French, has established the bases for a more abstract conception of the intonational structure. This gives floor for a compositional semantic relation between the meaning of the sentence on the one hand and the meaning of the intonational contour on the other hand. These seminal proposals gave impulse to an intonational phonology framework where the relationships between form and meaning will be refined, as will be developed in the following sections.

3.2. Discrete intonational meanings and gradient paralinguistic functions

One of the most interesting advances of intonational phonology, as theorized by Ladd (1996, 2008) and Gussenhoven (1984, 2004), is the proposal to distinguish between a discrete phonological component of intonation and the gradual phonetic variations of their realization, both contributing to intonational meaning. On the semantic side, phonological categories are

generally associated with linguistic meanings that are language specific while gradual phonetic variations rather convey paralinguistic functions.

As soon as 1984, Gussenhoven proposed a model of British English stating that the meanings of three nuclear tonal configurations can be composed of the meanings of four phonetic 'modifications' applying to them. Table 1 below describes the twelve resulting compositions.

	Fall	*Fall-rise*	*Rise*
Delay	Addition + non-routine	Selection + non-routine	Relevance test + non-routine
Stylisation	Addition + routine	Selection + routine	Relevance test + routine
Half-completion	Addition + not surprising	Selection + not surprising	Relevance test + not surprising
Range	Addition + insistence	Selection + insistence	Relevance test + insistence

Table 1. – The twelve semantic compositions resulting from the meanings of the three nuclear tones of British English and their four phonetic modifications. The tonal meaning precedes the modification meaning in each square of the table. From Gussenhoven (1984).

Between 1984 and 2004, Gussenhoven refined his approach of the meaning of continuous phonetic variations of intonation, thanks to his work on a large body of various languages and under the influence of the ethological notion of "frequency code" proposed by Ohala (1983). The frequency codes make it possible to associate the high vocal frequencies (high f0) with small larynxes of small animals and the low frequencies (low f0) with the large larynxes of big animals. Gussenhoven (2004) used this concept again and added two new biological codes: the "effort code" associating a greater effort with a larger amplitude of f0 variation, and the "production code" associating high f0 values with speech constituent beginnings and low f0 values with constituent ends. Although Gussenhoven hypothesized that the phonological variations of intonation result from the grammaticalization of patterns coming from the three biological codes, he distinguished clearly between the language specific arbitrary meanings of phonological configurations and the universal meanings associated to continuous variations. Among the latter, he separated affective meanings from informational meanings. For instance, for the frequency code, high f0 values are associated with the affective meanings of submission, vulnerability and sympathy but with the informational value of uncertainty. The low f0 values are associated with affective values of authority, protection and antipathy and with the informational value of certainty.

Ladd (1996, 2008) developed a similar idea. He formulated it as follows: "I believe that, at a fairly low level of analysis, paralinguistic cues should be

regarded as *modifications of the way in which phonological categories are realised*." (2008: 35, underlined by the author). The paralinguistic cues conveyed by intonation (pitch range, intensity and voice quality) are slightly different from those of Gussenhoven: they differ from linguistic cues by the gradient nature of their variation. This is one of the reasons why they are particularly well suitable for conveying emotional information that are themselves gradually interpreted (one can be more or less angry, more or less happy, more or less excited, etc., see Scherer, Ladd and Silverman, 1984).

Note however that these associations between discrete and linguistic on the one hand, gradual and paralinguistic on the other hand, are not always clear cut, as Grice and Baumann pointed out: "it is not possible to state either that categorical means are used to express only linguistic functions, or that gradient means are used only for paralinguistic functions, although this is a widespread assumption." (2007: 15).

Although it is not explicitly stated, except in Gussenhoven's (1984) proposal, discrete intonational meanings and gradual functions can be conceived as composing with each other as well as with the sentence meaning. The main virtue of Gussenhoven's and Ladd's proposals is precisely to separate analytically and abstractly different amalgamated components within the complex measurable speech data. Semantically, the notion of compositionality offers the conceptual tool adapted to that analysis.

4. THE INTERNAL ANALYSIS OF THE CONTOUR

Some authors have proposed to analyze the intonational contour itself and to distinguish its morphological-like components whose meanings compose to form the global meaning of the contour.

The most emblematic proposal of this kind of approach is due to Pierrehumbert and Hirschberg (1990) and concerns the semantics of American English contours inventory.

4.1. Pierrehumbert and Hirschberg (1990)

Pierrehumbert and Hirschberg's conception of intonational meaning is based on the phonology of American English intonation that Janet Pierrehumbert elaborated in her PhD dissertation and then in her collaboration with Mary Beckman (Pierrehumbert, 1980; Beckman and Pierrehumbert, 1986). Intonational contours are decomposed in three types of tonal configurations with different phonological properties. All three are composed of tones T that can be high (H) or low (L). "Pitch accents" T* are associated with metrically strong syllables that themselves are phonological properties of lexical items. "Phrasal tones" T or T- mark the boundaries of the intermediate phrase (ip) and can spread over several syllables. Finally, "boundary tones" T% mark the boundaries of the intonational phrase (IP). The intonational contour of an intonational phrase, usually mapping a clause,

is therefore at least the combination of three tones: T*T-T%. However, it can also contain several T* and several T-. Moreover, a pitch accent can be made up of the combination of two tones and is then called a bitonal pitch accent L+H or H+L. In this case, the first or the second tone bears the star that signals its association to the metrically strong syllable.

The meaning conveyed by the tones closely depends on the nature of the tone: T* convey the informational and dialogical status of the lexical items that bear them (new, important, shared or not); T- relate to the content of a whole ip constituent and signal whether one should interpret it conjointly with the content of the succeeding ip or not; T% relate to a whole IP and also signal whether one should interpret its content conjointly with that of the following IP.

In example (3) below, syllables in capital letters correspond to accented syllables. An H* indicates that the interlocutor must add the referents introduced by expressions bearing this tone to the common ground. Conversely, the absence of a T* on the word "beans" signals that this information is already shared by the participants. L- and L% respectively indicate that the utterance and the speech turn (the answer to A's question) should not be interpreted conjointly with what follows. In example (4), the second L* indicates that the content is already shared by the participants but must be taken into account now. The final H% signals either that the speaker will continue to speak or that he will wait for a reaction on the part of the addressee (for instance to apologize for his misplaced proposal).

(3) A: Who ate the beans?
B: FRED ate the beans.
H* ø L-L%

(4) A: Let's order a Chateaubriand for two.
B: I DON'T eat BEEF!
L* L* L-H%

Pierrehumbert and Hirschberg's article also briefly mentions the role of other components of intonation, such as pitch register, speech velocity or voice quality, which add their specific contribution to the utterance meaning. Although this point is not developed in their paper, we can conclude that the authors at least partially share Gussenhoven's and Ladd's point of view concerning the separation between the discrete phonological and the gradual paralinguistic dimensions of intonational meaning and their composable nature.

However, the main contribution of Pierrehumbert and Hirschberg's proposal is to apply compositionality to the components of the contour itself, thanks to a finer analysis of the phonological form of the contour.

At the same time, their paper shows a very elaborate conception of the semantic dimension of intonational meaning which relies more clearly than preceding proposals on notions borrowed from the semantic literature. For

instance, referring to Grosz and Sidner's (1986) work, Pierrehumbert and Hirscherg underline the role of intonation in structuring discourse, and they also claim that contours give some information about the participants' intentions and about the given or new status of discourse referents, and finally explain how contours modify the knowledge shared by the interlocutors. Pierrehumbert and Hirschberg's attention to the results of semantic theory certainly explains why semanticists rather than phonologists used again the idea of contour internal compositionality, as illustrated for instance by the work of Steedman (2007) or more recently of Krifka (to appear).

4.2. Steedman (2004) and the three components of intonational meaning: information structure, commitment and disagreement

Steedman claims that information structure (IS) can be analyzed in a fully compositional manner. He proposes that IS is not an autonomous level of the grammar and suggests integrating prosodic information to surface syntactic information in order to compositionally calculate the logical form of an utterance and the meaning that it takes in context.

To do so, he relies on the tonal description of English elaborated in Pierrehumbert (1980) and Beckman and Pierrehumbert (1986) and aims at representing intonational meaning through the analysis of the respective contributions of pitch accents and boundary tones. Three dimensions must be distinguished:

- First, the opposition between theme "θ" and rheme "ρ",
- Second, the opposition between consensual information and conflictual information, marked through the features [± AGREED],
- And third, the opposition between the commitment of the speaker, noted [S], and a commitment attributed to the hearer, noted [H].

According to Steedman, pitch accents are used to distinguish one piece of information among a set of information that could have been uttered. Therefore, all pitch accents are contrastive. Some of them mark the theme (L+H* and L*+H), while the others mark the rheme (H*, H*+L, L* and H+L*). Some mark consensual information (L+H*, H* and H*+L), while the others mark potentially conflictual information (L*+H, L* and H+L*). Table 2 below sums up the contrasts.

	[+ AGREED]	[– AGREED]
θ	L+H*	L*+H
ρ	H*, H*+L	L*, H+L*

Table 2. – Semantic contrasts attributed to English pitch accents in Steedman (2007).

Boundary tones are used to indicate who among the participants assumes the content of the sentence to be true or false. L%, LL% and HL% boundary

tones signal the speaker commitment, while H%, HH% and LH% signal that commitment is attributed to the hearer.

Examples (5) and (6), borrowed from Steedman (2007), illustrate his proposal. In (5), the utterance is totally rhematic, without a theme, and this is marked by the presence of a single H* pitch accent. H* signals that the rheme is presented as consensual and the boundary tone LL% indicates that the speaker S is commited to it. This is the standard situation where participants alternatively add information to the common ground. Conversely, (6) presents an utterance where the speaker S contradicts what the hearer H has just said by using an L* pitch accent that indicates that the rheme is presented as conflictual.

(5) H: You appear to be rich.
S: I'm a MILLIONAIRE.
H* LL%

(6) H: You appear to be poor
S: I'm a MILLIONAIRE.
L* LL%

Steedman hence proposes a compositional analysis of English contours since each tone contributes compositionally to the overall meaning. The originality of his proposal is to make the three semantic dimensions that are relevant for intonational meaning – information structure, participant commitments and the potential disagreement between them – explicit. Building on Pierrehumbert and Hirscherg's (1990) proposal, Steedman's contribution is more elaborated on the semantic side: the set of relevant meanings is presented in a systematic way through the articulation of three oppositions. It also shows how some meanings that are attributed to intonation in the literature (such as topic continuation, interrogative illocutionary force or different values of epistemic modality) actually derive from intonational contours and should be analyzed as conversational implicatures triggered by the interaction of the literal meaning of the intonation contour with contextual information. Finally, Steedman's introduction of disagreement as a component of intonational meaning shows that this meaning is essentially dialogical rather than illocutionary or epistemic. As a result, it is necessary to substitute an interactional semantics for a truth-conditional semantics because participants not only exchange information but also negotiate it.

5. PERSPECTIVES IN PREPARATION FOR AN APPLICATION TO FRENCH

Even for English, the highly compositional analysis initiated by Pierrehumbert and Hirschberg (1990) and pursued by Steedman (2007) faces several problems and is the subject of a debate that we will briefly summarize in Section 5.1 below. Section 5.2 will then propose several ideas towards a compositional approach of the semantics of French intonation.

5.1. The debate about English

The analysis proposed by Pierrehumbert and Hirschberg (1990) presents itself as work in progress for a compositional semantics of English intonation. Actually, their proposal gives rise to several difficulties that are acknowledged by the authors themselves as well as by the defenders of alternative proposals.

Pierrehumbert and Hirschberg recognize that the meanings of bitonal pitch accents L+H and H+L are very difficult to distinguish. Note however that Steedman finds a solution to this problem by stating a new semantic distinction: bitonal L+H signal thematic information while bitonal H+L signal rhematic information.

Another controversy concerns the claim that even the tones composing bitonal pitch accents should be morphemes associated to meanings that could be composed to produce the meaning of the complex pitch accent. For instance, the bitonal L+H* conveys a meaning which is elaborated from the meaning of the single tone H*. While H* indicates a new referent, the bitonal L+H* is preferentially used when the referent is not only new but also contrastive. Actually, Pierrehumbert claims that intonational phonology, contrary to segmental phonology, does not include units of second articulation (structural units without meaning like segments). All tones are potentially morphemes and never non significant components of morphemes. This radically morphological conception of intonational primitives was taken up by Truckenbrodt (2012) but not by Steedman (2007) for whom bitonal pitch accents are not decomposable into meaningful subparts.

There is also a debate concerning which entity contours are anchored down to and the nature of their contribution. According to Pierrehumbert and Hirschberg (1990) as well as to Steedman (2007), pitch accents and boundary tones relate to prosodic constituents that are not obligatorily associated to a propositional content. They can also be anchored onto a noun phrase and signal that the referent of that phrase is new (for H* in Pierrehumbert and Hirschberg 1990) or that it is the theme of the phrase (what Steedman 2007 proposes for H*). In both cases however, the semantic contribution of the whole contour is compositionally related to a proposition built up from the propositional content of the clause. Conversely, Truckenbrodt (2012), building on Bartels (1999), argues that intonational contours do not always get their meaning from the meaning of the constituent they are related to, nor from the propositional content of the clause they belong to. According to him, contours are not comparable to modal operators that would modify a propositional content p by adding *I doubt that p*, *I am sure that p* nor even *Is that p?* Actually, contours can apply to other types of content than the propositional content of the utterance. They can apply to any propositional content that is salient in the context, especially presuppositions and implicatures of the utterance. This claim allows Truckenbrodt (2012) to offer a

unified analysis of interrogatives and jussive sentences that are not associated to propositional content per se. It also makes it possible to explain the contribution of intonation to fragments (elliptical or non verbal sentences) as well as to salutations and thanks. Recently, Ginzburg (2012) showed that expressions like *Hello* or *Thanks* are not associated to a propositional content but rather mark dialogical moments like the opening or the closing of an interaction. For instance, *Hello* does no more than indicate that the conversation begins. Prosody adds other kind of information to *Hello*, such as these two: *I listen to you kindly* or on the contrary *The interaction is conflictual*. A precise study of the intonation of these kinds of expressions in French remains to be done and would be useful to determine in a precise way the proper contribution of the prosody to the meaning.

Examining the debate concerning English compositional intonation, we can draw the following conclusions: a) all compositional approaches to intonational meaning adopt a tonal representation of the contour, b) it is not clear from the debate on bitonal pitch accents whether intonational phonology has a double articulation (including a second articulation) or not; c) the meaning contribution of intonation affects various types of propositional contents: the *at-issue* content of the utterance, implicatures, presuppositions and expressive contents associated with the utterance, but also contextual information that is prominent in the context of the utterance. Further studies on other languages will help to clarify these issues. In the following section, we propose some lines of inquiry towards a compositional semantic of French intonation.

5.2. Application to French of a strongly compositional approach of intonational meaning

The study of French intonation has a long and rich tradition within which intonational contours and their meanings have been studied in different frameworks. However, in only a few approaches attempts have been made to reach strong compositionality. A major exception is Mertens (2008) who proposed a very fine-grained conception of French intonation including compositionality of the meanings. Each syllable bears a tone or a complex of two tones; the tones are represented by small letters for unaccented syllables and by capital letters for accented syllables. Only tones associated to accented syllables convey meanings that compose to give the whole meaning of the phrase or the utterance. Another advantage of Mertens' (2008) proposal is to separate a "general semantic" meaning from "contextual meaning effects". For instance, the tone B- (meaning "extra-bas" *very-low*) has "finality" as its general semantic meaning but may convey a default assertive mood or a peremptory mood depending on contextual factors.

Despite the importance of Mertens' proposal for French intonational phonology, and its relevance for the present issue, we do not adopt his

framework here. Rather, we couch our proposal in the autosegmental-metrical framework (AM framework) for which not all syllables, but only metrically strong syllables and edges of phonological constituents, bear tones (see section 4.1. above for details). Moreover, the meanings proposed by Mertens are borrowed from the prosodic literature: consequently, they are quite heterogeneous, sometimes roughly defined, and they are not systematically organized. Instead, we adopt meanings defined in a more straightforward semantic manner, attempting to more systematic generalizations.

In order to do so, we largely borrow from Steedman's (2007) proposal. We first present our proposal in section 5.2.1, and then discuss it in section 5.2.2.

5.2.1. Preliminary insights for a compositional semantic of French intonation

First, we should point out that we do not mention here the role of the initial rise which is an optional rise that may occur on the first syllable of the first content word of phrases, despite its putative role in the marking of information structure (Di Cristo, 1999; German and D'Imperio, 2015; Beyssade *et al.*, 2015) and topic shift (Marandin *et al.*, 2002), among other pragmatic functions. Instead, our preliminary attempt focuses on the various combinations of pitch accents and boundary tones at the right edge of intonational phrases.

In line with Steedman, we assume that intonational meaning involves two contrasts: i) a contrast between information presented as consensual and information presented as potentially conflictual [± AGREED], ii) another contrast between the attribution to the speaker [S] or to the hearer [H] of the responsibility of the validation of the content. Our claim, summed up in (7), is that in French intonation the first contrast is marked by the choice of the pitch accent while the second contrast is marked by the choice of the boundary tone. Moreover, we introduce a third contrast between two bitonal H+L pitch accents: H*+L for the rise-fall aligned with the last syllable ("implication" in Delattre, 1966) and H+L* for a rise-fall with the peak on the penultimate syllable. The contrast in meaning we propose between the two is a degree of disagreement: H+L* marks a stronger disagreement, noted [>], than H*+L which marks a weaker disagreement, noted [<][2].

[2] In the first proposal for a French version of ToBI (Delais-Roussarie *et al.* 2015), our H+L* is coded H+!H* and our H*+L corresponds to H*. We believe that these differences in coding are far less important than the semantic contrasts at stake.

(7) [– AGREED]: H+L (realized as either H+L* [>] or H*+L [<])
[+ AGREED]: H*, L* and L+H* (the contrast between these different pitch accents has to be further explored)
[S]: L% (the speaker takes the responsibility for the truth of the content)
[H]: H% (the responsibility for the truth of the content is delegated to the hearer)

Hence, contrary to Steedman (2007), we do not include the theme/rheme opposition in our proposal. Indeed, up to now, research on information structure in French has shown that its marking involves the following components: syntactic structure (Lambrecht, 1994), deaccenting (Di Cristo, 1999; Jun and Fougeron, 2000; Beyssade *et al.*, 2015), phrasing (Féry, 2001; Dohen and Lovenbrück, 2004) and, as mentioned earlier, the occurrence of the initial rise. Apparently though, the choice of pitch accent and boundary tone, which is under discussion here, is not directly involved in information structure marking in French.

Our proposal therefore distinguishes three pairs of semantic primitives to contrast the choices of pitch accents and boundary tones at the end of intonational phrases. Each pair is represented by a pair of semantic features: [+ AGREED] / [– AGREED], [S]/[H] and [>]/[<]. Their meanings are slightly different from Steedman's. In particular, the contrast [S]/[H] is reformulated: [S] means that the speaker commits himself to the content of the utterance and presents himself as able to give evidence or arguments in favor of that content; [H] means that the speaker delegates the burden of the commitment and of the evidence to the hearer. This reminds us of the distinction made by Gunlogson (2008) between the commitment and the source of the commitment: when a speaker presents a content without being its source, she says that the commitment is "dependent". In French, H% marks such dependence. Table 3 below shows the different intonational contours (combination of a pitch accent and a boundary tone) that are contrasted by these three pairs of features.

	[– AGREED]		[+ AGREED]
	[>]	[<]	
[S]	H+L*L%	H*+LL%	L*L%
[H]	H+L*H%	H*+LH%	L+H*H%

Table 3. – Six intonational contours of French intonation contrasted following the meaning of their pitch accent (columns) and of their boundary tone (raws).

The global meaning of each contour, when it is anchored onto a declarative sentence, can hence be formulated as follows:

– L*L% conveys a simple assertion.
– H+L*L% conveys an assertion usually associated with an indignant connotation.

- H+L*H% expresses incredulity on the part of the speaker concerning the content of the utterance.
- H*+LL% corresponds to the implication contour in Delattre (1966) and conveys both the speaker commitment and a call on the hearer to join him/her despite his potential disagreement.
- L+H*H% conveys a confirmation request.
- H*+LH% conveys a confirmation request and the presupposition that the hearer shows a certain degree of reluctance to give an answer.

In the following section we discuss our proposal both on the phonological and the semantic side.

5.2.2. Discussion

The proposal detailed in the preceding section is based on an elaboration of the inventory of pitch accent types in French, and of the semantic contribution of the different types of tone. However, in order to escape circularity, it is necessary to be careful about the independence of the phonological and the semantic proposals.

The tonal coding we displayed in (7) and in Table 3 is the result of a synthesis of several proposals found in the literature. For instance, the coding of the two pitch accents L+H (H*+L and H+L*) is borrowed from Ladd (2008: 122). It makes it possible to give a unified underlying structure L+H to the two pitch accents that convey disagreement through the [– AGREED] feature. Portes *et al*. (2012) proposed the coding L+H*H% for the « continuation contour » that has otherwise been shown to be very difficult to formally distinguish from declarative polar questions (Post, 2000: 126-127). Moreover, Post distinguishes two different rise-falls from the penultimate by the different specification of their boundary tone. One is falling down to the bottom of the speaker's range, it has an L% boundary specification and it is said to convey obviousness. The other contour falls down to the middle of the speaker's range, its boundary tone is coded 0% and it is said to convey the lack of speaker commitment. "0" in 0% actually signals that the boundary tone is scaled at the same height as the preceding tone. Furthermore, Michelas *et al.* (2015) experimentally get the realization of a boundary tone H% after a rise-fall with the peak on the penultimate in contexts expressing the incredulity of the speaker concerning the utterance content and a request to the hearer to state on the utterance truth value. Two interesting conclusions result from these works: 1) even in French it is possible to dissociate the pitch accent from the boundary tone, despite the conjunction of T* and T% on the same syllable due to the accentuation of the last syllable of the phase; 2) the meanings associated to the rise-fall from penultimate by both Post and Michelas *et al.* are compatible with Steedman's conception of the boundary tones: L% conveys the speaker commitment (obviousness) and

H% the attribution of (the burden of) the commitment to the hearer (incredulity and confirmation request).

We also need to explain our borrowing of the contrast [± AGREED] from Steedman. Portes (2004) showed the "polemical" meaning of both the rise-fall on the last syllable (H*+LL%) and the rise-fall from the penultimate (H+L*L%) in a corpus study of a radio debate.

Our proposal differs from Beyssade *et al*. (2004, 2007) and Marandin (2006) concerning the meaning of rising contours. These authors distinguish two different rising contours, a simple rise and a rise-fall, that convey the same meaning: the speaker anticipates a possible disagreement with the hearer and he/she is not ready to revise his/her own beliefs (see Figure 1 in Section 2. above). However, in French, rising declaratives do not always convey a bias indicating the commitment of the speaker towards the truth of the content; they can also convey unbiased polar questions (Beyssade, 2013; Portes and Reyle, 2013; among others). It is thus necessary to abandon the idea that all non-falling contours are associated with a strong commitment of the speaker, as assumed by Beyssade *et al*. and Marandin. As a consequence, the hierarchical structuration of the meanings that they proposed is also lost.

Conversely, the analysis described in (7) above formally and semantically distinguishes the unbiased declarative polar question from the biased one. The unbiased declarative polar question corresponds to the contour L+H*H% that conveys the semantic feature [+ AGREED]. The confirmation requests that are biased correspond to the contour H*+LH% and convey the semantic feature [– AGREED]. Hence, this latter contour has the same pitch accent H*+L as the "implication" contour but with an H% boundary tone instead of an L% one. This pitch accent H*+L is phonetically realized with an earlier rise than the L+H* pitch accent, as shown by Portes (2004) comparing the "implication" contour with the "continuation" rise. Semantically, the biased confirmation request H*+LH% actually conveys the feature [– AGREED] in accordance with its pitch accent, because it signals not only a bias of the speaker towards the content but also the suspicion that the hearer did not give some information in favor of the content although he/she could or should have. H% then conveys that it is the responsibility of the hearer to state the truth concerning the issue raised by the utterance.

This last contour made us reformulate the meaning of T% in terms of who is declared responsible for the truth of the content: L% signals that the speaker declares himself/herself responsible for the truth of the utterance content. Conversely, H% signals that the speaker delegates that responsibility to the hearer. This solution is interesting because it can be used to explain the meaning of so called "continuation" rises that are coded L+H*H% like unbiased polar questions. In the case of "continuation", H% can be interpreted as signaling that the speaker explicitly asks for the consent of the hearer to put the content to the common ground. This consent can then

be explicitly expressed in the form of a positive feedback, either vocal or gestural, or even compartmental if the hearer just does not respond.

Finally, our proposal to analyze the semantic difference between H+L* (rise-fall from penultimate) and H*+L (rise-fall on the last syllable) as a difference in the degree of disagreement between the interlocutors can be explained as follows: the connotations of "incredulity" for H+L*H% or of "indignation" for H+L*L% that are conveyed by H+L* signal a stronger disagreement than that conveyed by H*+L in the "implication" contour H*+LL% or in the biased request for confirmation H*+LH%. Note that this proposal is in line with Grice and Baumann (2007, see section 3.2. above) according to whom differences in degrees, potentially continuous, can be encoded categorically through pitch accent contrasts.

To conclude, we must insist on the fact that our proposal is very preliminary and requires further empirical work in order to be tested. As we have mentioned before, we did not treat the relationship between intonational meaning and information structure: this is of course one of the first steps to take to go beyond the present work. Last but not least, we did not treat the phonetics or the semantics of prosodic gradual variation. Nevertheless, like Ladd and Gussenhoven, we think that they play a crucial role to convey socio-psycho-physiological information concerning the speaker and that they also contribute to linguistic information, for instance by signaling reported speech. Research should head in this direction in order to fully understand prosodic meaning.

6. CONCLUSION

The overview of the literature presented in the first four sections of the present paper shows that, in order to elaborate a compositional conception of intonational meaning, it is more fruitful to have a fine-grained phonological conception of the intonational primitives and to dispose of a conception of conversation that can take into account the interactive and argumentative dimensions of meaning. Recent developments in the literature, both phonological and semantical, have offered new tools to reformulate the issue of intonational meaning.

In phonology, since 2000, the autosegmental-metrical framework has been successfully applied to French intonation, which has made it possible to use the different tonal configurations as primitives of the intonation structure. In semantics, a lot of work on dialogue has given rise to new research on non-assertive utterances and on speech acts. They have shown the importance of asymmetry between the position of the speaker and that of the hearer and the necessity to explore both consensual and conflictual exchange contexts. Besides, work on multidimensional semantics has shown the complexity of the utterance contents. They combine information on the world, questions, presuppositions, implicatures. Those informations can be reduced

to expressive meanings that the speaker makes public without the will to share them. A compositional analysis of intonational meaning needs to take these dimensions into account.

It is clear that intonational meaning cannot be reduced to illocutionary values or even to epistemic modality. But this does not mean that intonational primitives have no definable meaning. In spite of the preliminary nature of our analysis of French, we hope that this paper has at least shown that a compositional analysis of intonational meaning is all the more possible if the account of intonation is more phonological and the conception of meaning more semantical.

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