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## Information Packaging and Grammar Architecture\*

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There is increasing awareness of the large degree of crosslinguistic diversity involved in the structural realization of information packaging (or information structure). For instance, while in English the informational focus-ground articulation is realised mostly through prosody, Catalan makes predominant use of the word order dimension to achieve the same. This paper is concerned with how information structure should be optimally integrated into grammar. It proposes an analysis with the following characteristics: (1) information structure is an *integral part* of grammar since it interacts in principled ways with both syntax and phonology, (2) the representation of information structure in the grammar is *independent* of its particular structural realisation in different languages, and (3) there is a *direct analogous implementation* of the relationship between information structure and prosody in English-type languages and between information structure and the word-order dimension in Catalan-type languages. The framework utilised is HPSG. HPSG's multidimensional constraint-based architecture lends itself very well to expressing the mutual constraints on interpretation, syntax, and phonology that so diversely characterise focus-ground in different languages. The study of information structure, we argue, is essential in addressing fundamental questions regarding grammar architecture.

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Our point of departure is the assumption, expressed in e.g. Chafe 1976, Prince 1986, that what underlies the focus-ground distinction is a need to ‘package’ the information conveyed by a sentence so that hearers can easily identify which part of the utterance represents an actual contribution to their information state at the time of utterance, and which part represents material that is already subsumed by this information state. In particular, we adopt the proposal in Vallduví 1992 that these ‘ways of packaging’ can be viewed as instructions.

Section 1 provides a brief overview of information packaging and discusses the strategies that two language types, as represented by English and Catalan, exploit for realising information packaging. Section 2 outlines a way of representing information structure using the *sign-based* formalism of HPSG and looks at how language-specific generalisations can be expressed in this framework. Section 3 compares the proposal presented here with two alternative approaches.

## 1. Information packaging

The sentences in (1) differ not in *what* they say about the world, but in *how* they say it, i.e. they differ in the way their content is packaged:

- (1) a. He hates CHOCOLATE.  
 b. He HATES chocolate.  
 c. Chocolate he HATES.

These different packagings are viewed in Vallduví 1992, 1994 as different instructions for information update. The sentences in (1) have the same propositional content but encode different instruction-types. From a dynamic perspective these instruction-types can be viewed as transition-types from an input information state to an output information state. Each instruction-type—there are four of them—corresponds to a different focus-ground partition. The *focus* is defined as the actual update potential of a sentence *S*, i.e. the only contribution that (according to the speaker) *S* makes to the information state of the hearer at the time of utterance. All sentences have a focal segment.<sup>1</sup> The *ground*, in contrast, is already subsumed by the input information state and acts as an usher for the focus: it indicates how the information update is to be carried out. Sentences have a ground only if the context warrants its use, i.e. if the ushering is (thought by the speaker to be) required. The ground is further divided into *link* and *tail*. Link and tail each contribute in their own way to the ushering role of the ground. Links establish a particular locus of update in the input information state, while the presence of the tail indicates that a nondefault mode of update is (in the speaker’s eyes) required at that point in discourse.

This yields a complex articulation with three primitive notions that encompasses the two traditional two-way articulations of focus-ground and topic-comment.

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<sup>1</sup>The truth-conditional identity of the sentences in (1) is reflected in the fact that they yield the same output information state. Differences in update potential between sentences that differ only in the scope of their focal segments are, therefore, due to the fact that they can felicitously update different information states.

Two things follow from the way the informational primitives are defined. First, the focus-ground partition of a simplex sentence is composed of discrete units that do not overlap. A given constituent will be interpreted as focus, link or tail, but may not be interpreted as both focus and tail or focus and link. And second, every nonweak element in a sentence must contribute to its information structure.<sup>2</sup> This follows from the assumptions that in every sentence there is a focal segment and that sentences do not have a ground component unless the context requires its use: if a (nonweak) constituent is not ground, it must be focal, and if it is not focal it must be ground. This characterisation of instruction-type is independent of how a particular instruction-type is realised in particular languages. The structural realisation of these instruction-types differs from language to language. Let us look at how English and Catalan realise the three informational primitives (focus, link, and tail).

English and Catalan vary in their structural realisation of information packaging along two important dimensions of variation: whether the language has a malleable intonational structure—intonational plasticity—and whether the focus-ground structure affects the constituent order. This pattern is summarised in Table 1:

	English	Catalan
Intonation	plastic A & B accents	nonplastic A accent
String Order	links optionally front	ground in detachment slots

Table 1: Structural resources for realisation of information packaging

English has a malleable intonation. This contrasts with the nonplasticity of Catalan. In addition, English uses a richer repertoire of accents than Catalan, since it exploits both A and B accents.<sup>3</sup> In both languages focus is associated with an A accent. The difference between English and Catalan, as will be seen, is in how the association of focus and an A accent is attained. Links in English are associated with a B-accent realisation. Catalan does not possess a B accent. Links display no particular intonational prominence. Instead, what identifies them is that they are obligatorily left-detached. Catalan is precisely characterised by the need to place nonfocal phrases in right- or left-detachment slots: links are left-detached and tails are right-detached.

<sup>2</sup>The description ‘nonweak elements’ is meant to exclude weak proforms. Weak proforms (null pronouns and pronominal clitics in Catalan and unstressed pronouns in English) do not participate in the construction of instructions (see Vallduví 1992 for arguments in favour of this position). Strong proforms are nonweak.

<sup>3</sup>The terms A accent and B accent are taken from Jackendoff 1972. In Pierrehumbert’s (1980) phonology of intonation, A accents correspond to a simplex high pitch accent (H\*), generally followed by a falling boundary tone. Jackendoff’s B accent corresponds to a complex fall-rise pitch accent (L+H\*). This description of the intonational facts is an idealised picture which focuses on those aspects of intonation in English that correlate most directly with the focus-ground articulation. The use of intonation to express other pragmatic or semantic aspects of interpretation may override the default prosodic realisation of foci and links.

Left-hand placement of the link is also available, albeit optional, in English. However, its application on a given phrase does not preempt it being B-accented. Tails, finally, display no particular structural marking in English, other than being characteristically unaccented, but must necessarily undergo right-detachment in Catalan.<sup>4</sup>

Since the informational primitives that combine into instruction-types are associated with different realisations in different languages, the instruction-types themselves will be associated with different structures as well. Let us compare how two of the instruction-types are realised in the two languages under discussion. First consider English. Example (2) is a link-focus instruction: *the president* is the link and the verb phrase is focal. Example (3) is a link-focus-tail instruction: *hates* is focus and both *the president* (still a link) and the object *the Delft china set* are ground.<sup>5</sup>

- (2) a. H<sub>1</sub>: I'm arranging things for the president's dinner. Anything I should know?  
 b. S<sub>0</sub>: Yes. The **president** [<sub>F</sub> hates the Delft CHINA SET ]. Don't use it.
- (3) a. H<sub>2</sub>: In the Netherlands I got the president a big Delft china tray that matches the set he has in the living room. Was that a good idea?  
 b. S<sub>0</sub>: Nope. The **president** [<sub>F</sub> HATES ] the Delft china set.

These two sentences are licensed by different contexts. The context for (2) is often paraphrased with the question *What can you tell me about the president (that is relevant for my stated goal)?* and the context for (3) can be paraphrased—much less naturally—with the question *How does the president feel about the Delft china set?*

Compare these sentences to their Catalan counterparts. (4a) corresponds to (2), a link-focus instruction, and (4b) corresponds to (3), a link-focus-tail instruction:

- (4) a. El president<sub>1</sub> [<sub>F</sub> odia el joc de porcellana de DELFT t<sub>1</sub>. ]  
 b. El president<sub>1</sub> [<sub>F</sub> l<sub>2</sub>'ODIA t<sub>2</sub> t<sub>1</sub>, ] el joc de porcellana de Delft<sub>2</sub>.

In both languages the item within [<sub>F</sub> ] is associated with an A accent, although this association is brought about through different strategies. In the case of narrow focus on the verb (link-focus-tail), English simply changes the placement of the A accent from a sentence-final position to a sentence-medial position. The syntactic structure of the link-focus and link-focus-tail sentences is exactly the same. In contrast, in

<sup>4</sup>There is an important language-type which is not represented in table 1: languages that make use of morphology to realise information packaging. In many languages (Navajo, Vute) foci are associated with a particular morpheme. Other morphemes, as Japanese *wa*, can be straightforwardly characterised as a marker of linkhood.

In English, there are other 'marked' syntactic constructions, e.g. *it*-clefts, *wh*-clefts, that are also used to express informational partitions. However, as argued by Delin 1992, clefting serves other functions as well, such as the marking of presupposition (the kind that displays constancy under negation). Vallduví 1992 argues that this is the primary function of clefting and that its information-packaging value is secondary.

<sup>5</sup>Here and in examples below, where judged helpful, the B-accented element within the link is written in boldface. Foci are enclosed in F-labeled brackets and the A-accented item within the focus is written in small caps. In (2) and (3) S<sub>0</sub> is a presidential aid working in the White House. In (2) H<sub>1</sub> is a new butler joining the White House staff and in (3) H<sub>2</sub> is a cabinet member who has just returned from, say, a tour of the European Union.

Catalan link-focus and link-focus-tail have different syntactic structures. In the link-focus-tail example the object *el joc de porcellana de Delft* ‘the Delft china set’ appears in a detachment slot at the sentential periphery. Its peripheral status is evidenced by the presence in the verbal string of a pronominal clitic bound by the detached phrase, since the cooccurrence of clitic and argument in situ is illicit. Since Catalan lacks subject clitics, the clitic diagnostic cannot be used for the subject *el president* ‘the president’. However, the VOS status of Catalan and the peripheral status of subjects in structures like (4a) and (4b) has been argued for convincingly (see Vallduví 1992 for references). In effect, then, in (4a) and (4b) the A accent is associated with the rightmost accentable item within the sentential core. This is always the case: in Catalan A accents are necessarily associated with the right-hand boundary of the sentential core. Phrases (arguments or adjuncts) which, due to default string order, would otherwise appear in the rightmost position, must be removed from that position if association with an A accent is inappropriate, namely, if they are nonfocal. In fact, in Catalan the sentential core may contain only focal phrases.

In sum, informational primitives are correlated with different structural realisations in Catalan-type and English-type languages. In the former the structural correlates are syntactic, involving both dominance and precedence. In the latter the structural correlates are intonational, involving two types of accent.

## 2. An HPSG analysis

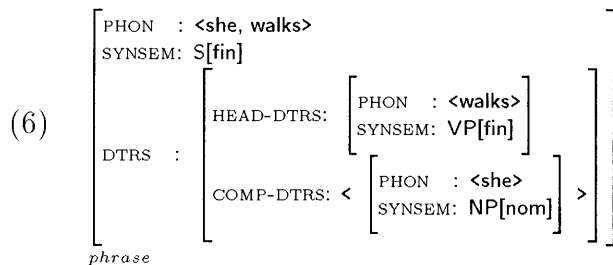
When learning a language, we learn to generate and comprehend sentences with particular information structures. Learning the particular strategies a given language uses to realise information packaging is an integral part of learning this language. Hence, information structure and its structural realisation need to be integrated into any complete grammar. This paper carries out this integration in a constraint-based grammar. The interaction of information structure with syntax and prosody in English and Catalan is illustrated using HPSG. The mutual constraints between dimensions available at every level in HPSG prove to be very useful in accounting for the realisation of information packaging in these languages in an elegant way.

In HPSG the relevant units of linguistic information are *signs* (Pollard & Sag 1994). They express phonological, syntactic, semantic and pragmatic information in an explicit fashion. Signs are formalised as typed feature structures. Each feature is an attribute-value pair which allows for recursion. *Lexical signs* contain the basic information about a word. One core idea in sign-based frameworks is that all relevant linguistic dimensions are represented in every linguistic unit, i.e. in words, phrases, clauses and sentences. The sign in (5) is the lexical sign for *walks*:

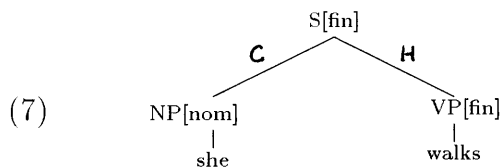
$$(5) \left[ \begin{array}{l} \text{PHON: } \langle \text{walks} \rangle \\ \text{CATEGORY: } \left[ \begin{array}{l} \text{HEAD: } \text{verb}[\text{fin}] \\ \text{SUBCAT: } \langle \text{NP}[\text{nom}] \boxed{1}, [\text{3rd}, \text{sing}] \rangle \end{array} \right] \\ \text{CONTENT : } \left[ \begin{array}{l} \text{REL : } \text{walk} \\ \text{WALKER: } \boxed{1} \end{array} \right] \end{array} \right]$$

The value of PHON in Pollard & Sag 1994 is simply an orthographic representation of the corresponding lexical item, e.g. *run*. The feature CATEGORY provides information about the inherent and combinatorial properties of a word. The CONTENT feature contains information about aspects of semantic interpretation which are assumed to be context-independent. Finally, CONTEXT (not represented in (5)) provides information relating to the pragmatic context of utterance. Feature structures allow many ways of organising different kinds of linguistic information and of describing the way this information interacts. A useful tool to express such interactions is *structure sharing* between relevant parts of a sign. In (5) there is structure sharing between the values in the SUBCAT feature in CATEGORY and the arguments of the roles in CONTENT. Structure sharing is indicated by the identity of the boxed tags.<sup>6</sup>

In addition to lexical signs, there are *phrasal signs*. They result from combining signs according to immediate dominance (ID) schemata. They have a *daughters* feature, DTRS, which represents the immediate constituent structure of the phrase:



Phrasal signs can also be represented in tree notation. (7) is equivalent to (6):



DTRS information appears at the end of the labelled arcs. These arcs are labelled H for head daughter and C for complement daughter. The PHON values for each lexical sign are written at the leaf below each daughter node. The rest of the information appears in the node labels.

Where should information structure be located in such multidimensional representations? Karttunen & Kay 1985, for instance, uses a feature NEW in the syntactic category of a phrase. Bird 1991 uses a FOC feature in CONTENT. However, the crosslinguistic facts discussed above advise against inherently associating information-structure information with only syntax or only phonology. Given the view of information packaging adopted here, it seems most natural to represent information-structure information within CONTEXT. We will enrich CONTEXT with a feature INFO-STRUCT as shown in (8), where the GROUND feature will take as values LINK and TAIL, corresponding directly to the informational primitives introduced in Section 1:

<sup>6</sup>CATEGORY and CONTENT are normally grouped into a single feature dubbed SYNSEM. Here we will retain a flat sign structure.

$$(8) \left[ \text{CONTEXT:} \left[ \begin{array}{l} \text{C-INDICES: [ ]} \\ \text{BACKGROUND: [ ]} \\ \text{INFO-STRUCT:} \left[ \begin{array}{l} \text{FOCUS:} \\ \text{GROUND:} \end{array} \right] \end{array} \right] \right]$$

The values of FOCUS and GROUND are instantiated, through structure sharing, with the constituents that realise the focus and the ground of the instruction, respectively. Thus, FOCUS, LINK, and TAIL take feature structures as values. The way the instantiation of these values comes about depends on the strategies found in each individual language. Let us look first at how pitch accent type and informational status constrain each other in English and how this interacts with word order in so-called focus projection. We then will turn to the use of detachment in Catalan.

Let us assume that the PHON field contains a feature ACCENT whose values are the A and B accents discussed above. These values are instantiated through the principles illustrated in (9a) and (9b):

$$(9) \quad (a) \left[ \begin{array}{l} \text{PHON|ACCENT: A} \\ \text{INFO-STRUCT|FOCUS: [1]} \end{array} \right] \quad (b) \left[ \begin{array}{l} \text{PHON|ACCENT: B} \\ \text{INFO-STRUCT|GROUND|LINK: [1]} \end{array} \right]$$

*word* *word*

The structure in (9a) is a skeletal lexical sign which says about itself that it contributes focal information. In a similar way, (9b) introduces a word with accent B that will be interpreted as a link. The pitch accent type and the value of INFO-STRUCT constrain each other. This is expressed by means of structure sharing between INFO-STRUCT and the sign itself. Presence of an A or B accent, then, is sufficient to identify positively the informational contribution of a lexical sign as focal or link. But not all lexical items in a sentence are associated with one of these accent types. Therefore, we need a third type of lexical sign as in (10):

$$(10) \left[ \begin{array}{l} \text{PHON|ACCENT: u} \\ \text{INFO-STRUCT: [ ]} \end{array} \right]$$

*word*

In this sign the value of the ACCENT feature is u (for ‘unmarked’). When ACCENT has this value, the value of the INFO-STRUCT feature is not specified. The informational contribution of this item can only be determined as it combines with other signs.<sup>7</sup>

In Pollard & Sag (1994:402) the phrasal signs for verb phrases and sentences are licensed by two ID schemata called Head-Complement Schema and Head-Subject Schema, respectively. These schemata specify that these signs must have a head daughter and a variable number of complement daughters. The head/complement distinction will be used in capturing the facts concerning instantiation of information structure in English. In addition, we need some way of expressing the constraints on the linear order of constituents. These are expressed through linear precedence (LP)

<sup>7</sup>The precise way in which unspecified information is represented will not be addressed. Also, the accent notation used here is obviously a simplification used for expository convenience.



statements. Precedence follows the obliqueness hierarchy of complements (among complements, the most oblique argument is the rightmost one). In addition to satisfying these ID schemata, the phrasal signs must satisfy the INFO-STRUCT instantiation constraints given in (11). These constraints capture the inheritance and projection of INFO-STRUCT values in English:

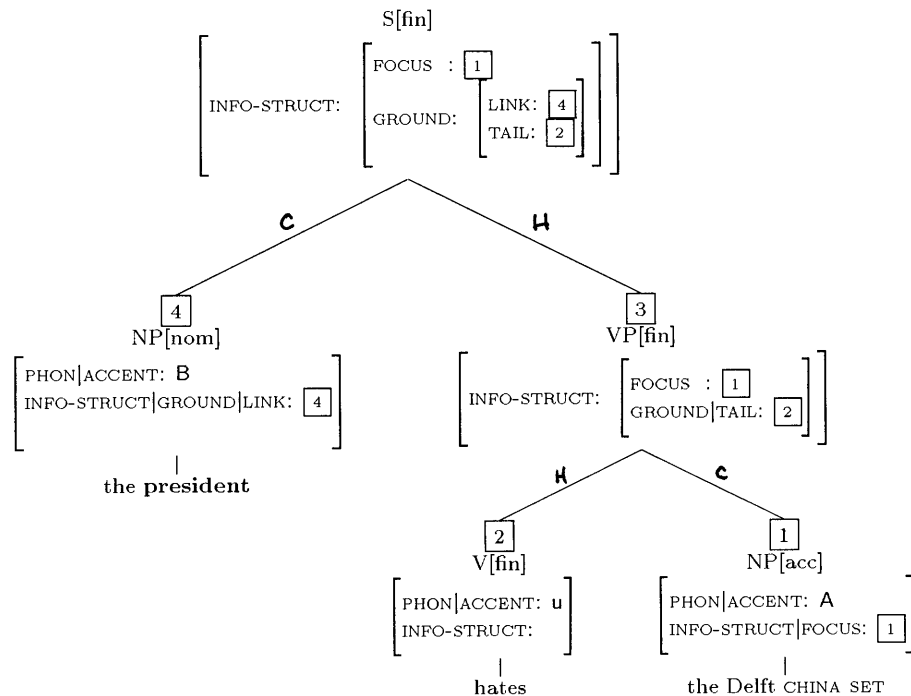
- (11) INFO-STRUCT *instantiation principles for English*:  
 Either (i) if a DAUGHTER's INFO-STRUCT is instantiated, then the mother inherits this instantiation (*for narrow foci, links and tails*),  
 or (ii) if the most oblique DAUGHTER's FOCUS is instantiated, then the FOCUS of the mother is the sign itself (*wide focus*).

To see how the value of INFO-STRUCT in phrasal signs follows from these principles, consider the two interpretations of sentence (12). This sentence, with an A accent on the object, can be interpreted either with narrow focus on the object noun phrase or with wide focus on the whole verb phrase (we assume a context such that in both cases *the president* is interpreted as link):

- (12) The **president** [<sub>F</sub> hates [<sub>F</sub> the Delft CHINA SET. ] ]

The narrow focus reading is licensed by (11i) (focus inheritance), while the wide focus reading is licensed by (11ii) (focus projection). The sign for the narrow focus case is in (13) (we omit many aspects of the sign that are irrelevant here):

- (13) *Object NP focus*:



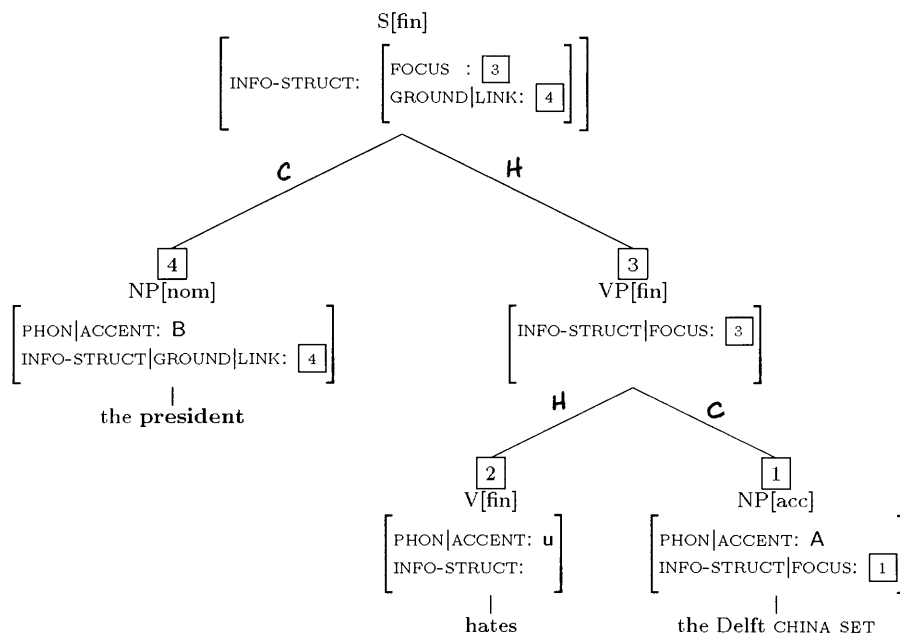
The B accent on the subject *the president* and the A accent on the object *the Delft china set* uniquely determine their informational status. Therefore, through (9), their

signs structure-share with the values of the LINK and FOCUS features, respectively. In the tree notation, the value of e.g. LINK in (13) is token-identical to the value of COMP-DTR, which appears at the end of the arc labelled C. In contrast, the unaccented verb *hates* does not by itself restrict its potential contribution. The value of its INFO-STRUCT remains uninstantiated (see (10)).

INFO-STRUCT in the VP[fin] sign must contain the information that the object is focal. This information is made available at the VP[fin] level through (11i): VP[fin] inherits the value of its INFO-STRUCT from its complement daughter. Once the INFO-STRUCT|FOCUS value of the VP[fin] sign is determined, the unaccented head daughter *hates* must be interpreted as instantiating the value of the mother's GROUND|TAIL (since, as noted, every element in the sentence *must* contribute to information structure). The values of INFO-STRUCT in S[fin] are also obtained via inheritance. The mother sign inherits the INFO-STRUCT instantiations from all its daughters by (11i): the object is the focus, the verb is a tail, and the subject is a link.

The structure for the wide focus reading is given in (14). It is identical to (13) except for the instantiation of the FOCUS value in the VP[fin] and S[fin] signs. Here, projection as in (11ii) may apply, since the most oblique daughter's FOCUS is instantiated. Therefore, the FOCUS value of the mother is the sign itself. At the S[fin] level, projection cannot apply anymore. S[fin] obtains its INFO-STRUCT values through inheritance as in (14):

(14) *VP focus:*



As is well known since Bresnan 1971, focus projection is only possible if the A accented item is the peripheral one. In (11ii) this is captured by explicitly stating that the complement daughter whose FOCUS value is instantiated has to be the most oblique one. Principle (11ii) correctly allows a wide-focus reading in (15a), while ruling it out in (15b):

- (15) a. The butler [<sub>F</sub> offered the president some COFFEE. ]  
 b. \* The butler [<sub>F</sub> offered the PRESIDENT some coffee. ]

The principles in (11) also account for the structural ambiguity of a certain class of strings where the subject is associated with an A accent. They allow for a reading with a narrow-focused subject and an all-focus reading (so-called thetic reading):

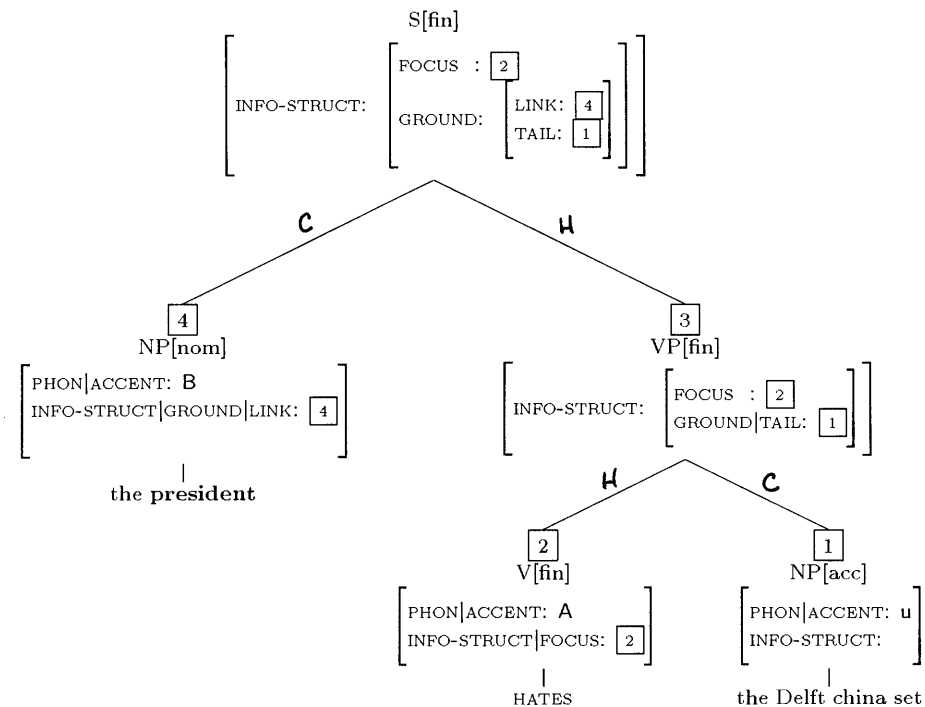
- (16) [<sub>F</sub> [<sub>F</sub> The PRESIDENT ] called. ]

Focus projection, i.e. the all-focus interpretation, is licensed. Principle (11ii) may apply because the subject is the only complement daughter of S[fin] and, hence, the most oblique one.

Principle (11ii) also refers to the head/complement status of the daughter whose FOCUS value is instantiated. This is necessary to rule out focus projection in cases like (17) in which the A accent is associated with the verb rather than a complement. The structure of (17) is shown in (18):

- (17) The president [<sub>F</sub> HATES ] the Delft china set.

- (18) *Verb focus:*



Here the value of FOCUS in VP[fin] is obtained via inheritance from the head daughter. There is no option for projection. Principle (11ii) cannot apply because no complement daughter of VP[fin] has an instantiated INFO-STRUCT|FOCUS feature. Instead the values of INFO-STRUCT are obtained via (11i). As a consequence, as in example (13) above, the unaccented NP[acc] daughter of VP[fin] cannot be interpreted as focal and instantiates the value of GROUND|TAIL in VP[fin]. We also predict that in cases like (19) there is no focus projection:

- (19) The **president** [<sub>F</sub> CALLED. ]

The verb *called*, whose FOCUS feature is instantiated, is not a complement daughter and, therefore, focus inheritance by (11i) must apply.<sup>8</sup>

An advantage of using the multidimensional representation in HPSG is that we are not forced to assume that focus-ground partitioning corresponds directly to structural units either in PHON or in DTRS. For instance, in (13) the GROUND material does not form a syntactic constituent, but the appropriate instantiations are achieved by a combination of bottom-up (accent assignment) and syncategorematic processes (Head-Complement schema). The same applies to the case in (14) where only the verb is focused. We are thus not forced to assume, as does Steedman (1991), that informational partitioning must correspond both to syntactic constituency and intonational phrasing.

Let us now turn to Catalan. As noted, in Catalan informational interpretation is signalled by syntactic position rather than by accent type. Examples (20) to (22) illustrate the particular pattern found in Catalan. Every (nonweak) phrase within the sentential core is interpreted as focal. In (20) the string verb+oblique+subj is the focus of the sentence:

- (20) Ahir [<sub>F</sub> va tornar a Barcelona el PRESIDENT. ]  
 yesterday 3s-past-return to Barcelona the president  
 ‘Yesterday the president returned to Barcelona.’

If an argument of the verb is to be interpreted as nonfocal, it is necessarily clitic-dislocated or, equivalently, detached away from the sentential core. This is the case with the locative in (21) and the subject in (22):

- (21) a. A Barcelona<sub>1</sub> [<sub>F</sub> hi<sub>1</sub> va tornar t<sub>1</sub> el PRESIDENT. ]  
 b. [<sub>F</sub> Hi<sub>1</sub> va tornar t<sub>1</sub> el PRESIDENT, ] a Barcelona<sub>1</sub>.
- (22) a. El president<sub>1</sub> [<sub>F</sub> va tornar a BARCELONA t<sub>1</sub>. ]  
 b. [<sub>F</sub> Va tornar a BARCELONA t<sub>1</sub>, ] el president<sub>1</sub>.

As noted in Section 1, phrases associated with a link interpretation are left-detached whereas phrases associated with tail interpretation are right-detached. The only difference between the (a) and the (b) sentences in (21) and (22) is in the ground informational contribution the detached phrases make. In order to introduce left- and right-detached phrases, we postulate a language-particular ID schema that introduces these phrases as sisters of S and simultaneously determines that their INFOSTRUCT|GROUND value is instantiated:<sup>9</sup>

<sup>8</sup>It has been claimed that examples like (19) may have an all-focus reading. However, Vallduví 1992, among others, argues that the subject in these sentences is always ground, even when such sentences answer questions of the type *What's new?*

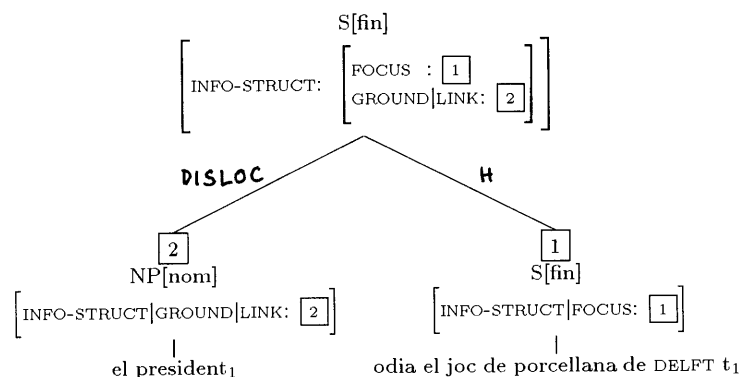
<sup>9</sup>Systematic differences between this kind of detachment and other unbounded dependencies motivate the use of a novel Head-Dislocation Schema rather than subsuming these constructions under the Head-Filler Schema used in Pollard & Sag 1994.

(23) *Head-Dislocation Schema for Catalan:*

The DTRS value is an object of sort *head-disloc-struct* whose HEAD-DTR|SYNSEM|LOCAL|CATEGORY value satisfies the description [HEAD *verb*[VFORM *finite*], SUBCAT <>] and whose DISLOC-DTRS|CONTEXT|INFO-STRUCT|GROUND value is instantiated and for each DISLOC-DTR, the HEAD-DTR|SYNSEM|LOCAL|CONTENT value contains an element which stands in a *binding* relation to that DISLOC-DTR.<sup>10</sup>

The first clause requires the head-daughter to be a finite sentence. The second clause requires that the informational contribution of dislocated phrases be GROUND. Note that the schema allows for more than one dislocated phrase, which is desirable given that there are no ordering restrictions on dislocations. The association between the directionality of the detachment and the GROUND value can be captured using an LP statement to constrain the order in which link, focus, and tail are realised in Catalan. Thus, if we state that the order must be link>focus>tail, it will follow that left-detachments are always associated with linkhood interpretation and right-detachments with tailhood.

The instantiation of INFO-STRUCT in phrasal signs in Catalan is very simple. Material within the core clause is always instantiated as FOCUS. We can stipulate that the value of INFO-STRUCT in the core S[fin] sign is always itself. With this proviso, it is easy to see that Catalan makes use only of inheritance (11i). When the core S[fin] unifies with the clitic-dislocated constituents, the mother S always inherits the INFO-STRUCT instantiations of the daughters. There is no focus projection. The structure in (24), which corresponds to example (4a) in Section 1, illustrates a left-detachment structure where the DISLOC-DAUGHTER is interpreted as a link:

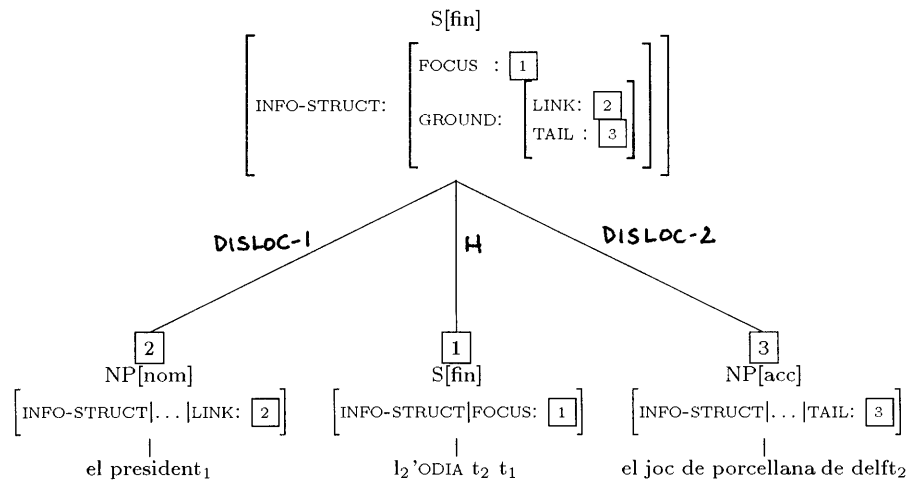
(24) *Clitic left-dislocation:*

The entire head daughter, i.e. the sentential core, is the FOCUS value of the top S[fin]. The LINK value of the top S[fin] is inherited from the left-detached daughter.

A case of simultaneous left- and right-detachment is given in (25), which corresponds to example (4b). Here the top S[fin] inherits its INFO-STRUCT values from its daughters. The head daughter provides the FOCUS value, the left-detached daughter the LINK value, and the right-detached daughter the TAIL value.

<sup>10</sup>This binding relation covers both coreference and subsumption (see Dorrepaal 1994)

(25) *Clitic left- and right-dislocation:*



We have expressed the relationship between intonation and information structure in English by simultaneously specifying the ACCENT and INFO-STRUCT values and by subjecting them to the instantiation principles in (11). In Catalan the information-packaging contribution of a phrase is determined by its syntactic position. Again, we have linked the instantiation of INFO-STRUCT to a grammatical schema, in this case, an ID schema which licenses a particular configuration. This expresses the direct interaction between information structure and the two structural dimensions involved appropriately. Analogous strategies have been employed in the two languages.

### 3. Other approaches

Steedman 1991 proposes an integration of information structure into grammar using a Combinatory Categorical Grammar (CCG). CCG and HPSG share the idea that each linguistic unit—signs or categories—contains all phonological, syntactic, and semantic information pertaining to that unit. Steedman enriches categories with an intonational dimension which is intimately tied in with information structure. His information structure contains two primitives: *rheme*, which corresponds to focus, and *theme*, which corresponds to ground. There is no equivalent of the distinction between link and tail. Focus inheritance and focus projection are handled through standard combinatory rules that apply on a rich intonational structure, involving not only two types of pitch accent but also different types of boundary tones.

Steedman, however, assumes complete isomorphy between information structure, intonational structure, and syntactic constituency. His Prosodic Constituent Condition (1991:279) states that two syntactic categories can combine only if their prosodic categories can also combine. This requires that, say, the focus of a sentence—which is associated with a particular intonational phrase—correspond to a syntactic constituent. Our proposal differs in that no syntactic constituency is required for any informational unit as long as inheritance of INFO-STRUCT values proceeds in the permitted fashion. In fact, we do not require syntactic contiguity either. Given

the existence of examples like (17) where the ground is made up of discontinuous segments, we consider this a positive feature of the HPSG analysis.

As noted in Section 1, linkhood is associated with a B accent in English but a left-hand syntactic slot in Catalan. Focushood, while free to associate with any constituent in English, is inherently associated with the core S[fin] in Catalan. We take this to indicate that in Catalan one should express the combination of focus and ground elements independently of the phonological dimension, just as we largely ignored the syntactic dimension of the sign in expressing the realisation of information structure in English. The HPSG analysis allows us to express the mutual constraints that hold between syntax and information structure in Catalan without having to assume that either of these dimensions is isomorphic to intonational structure. This differs from the CCG analysis, where intonational structure necessarily reflects syntactic structure.

A different proposal is found in Vallduví (1992:115-138). It uses a GB-based multiple-level architecture. In (most versions of) GB each sentence is a bundle of abstract levels of representation. Each level of representation structurally represents one of the different linguistic aspects of the sentence. For instance, D-structure is a pure representation of argument or  $\theta$ -structure and LF is a representation of operator-variable relations. Which level should information-packaging relations be represented at? Vallduví proposes the mapping between information packaging and the structural components through which it is realised be effected through a distinct, pure level of representation called IS (for information structure). This level feeds and bleeds the interpretive information-packaging component and consists of an unambiguous syntactic representation of information-packaging instructions.

This approach differs from the HPSG proposal put forth here in a number of respects. For one thing, the GB architecture does not allow for direct interaction between (suprasegmental) phonology and the interpretive components. Thus, in accounting for the English facts, we cannot bypass syntactic realisation in the way we did in Section 2. For instance, in the analysis above, the presence of ACCENT:B in a feature structure makes this feature structure the value of INFO-STRUCT|GROUND|LINK. It does not matter where the B-accented constituent is in the sentential structure. However, in Vallduví's (1992) proposal, linkhood necessarily has to be associated with a structural position, since there is no room for prosodic information at IS. The solution is to propose that at IS all links appear in the same structural position (i.e., those B-accented items that appear elsewhere in the clause move to that position in the mapping from S-structure to IS) and that it is this particular structural position which, at IS, is inherently associated with a link interpretation. Of course, the choice of structural position is not completely arbitrary: a left-hand IP-adjunction (or S-adjunction) slot. Indeed, English links may optionally appear in such a slot and Catalan links *must* appear in such a slot. But the fact that in English accent seems to be the crucial determinant of linkhood plays only a secondary role in such a model.

Analogous observations can be made with respect to tails and focus. Structural ambiguities of sentences where both focus inheritance and focus projection are pos-

sible are confined to PF and S-structure. Vallduví 1992 argues that at IS all ground elements must move to designated slots outside the sentential core, thus yielding disambiguated structures. For instance, example (12) in Section 2 would not be ambiguous at IS, since in the reading where *hates* is a tail, *hates* would have moved to a tail position. In the other reading, in contrast, no such movement takes place. English would differ from Catalan in that the former carries out in abstract syntax the syntactic operations that the latter carries out overtly.

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