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Information packaging in HPSG[*]

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1   Introduction

There is increasing awareness of the large degree of crosslinguistic diversity involved in the structural realisation 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.

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 sentence 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 Valldaví 1992, 1994 that these 'ways of packaging' can be viewed as updating instructions or, equivalently, as types of transitions between information states.

The paper is structured as follows. Section 2 provides a brief overview of information packaging. Section 3 discusses the strategies that two language types, as represented by

English and Catalan, exploit for realising information packaging. Section 4 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 5 compares the proposal presented here with two alternative approaches. Finally, in Section 6 we discuss some issues regarding the connection between information packaging and other semantic aspects.

2   Information packaging

Information packaging (a.k.a. communicative dimension, psychological structure) is a structuring of sentences by syntactic, prosodic, or morphological means that arises from the need to meet the communicative demands of a particular context.[1] In particular, information packaging indicates how linguistically conveyed information fits into the hearer's information state at the time of utterance. When communicating a proposition ϕ, speakers may realise it by means of different sentential structures according to their beliefs about the hearer's knowledge and attentional state with respect to ϕ. The term 'packaging' is due to Chafe (1976):

> I have been using the term *packaging* to refer to the kind of phenomena at issue here, with the idea that they have to do primarily with how the message is sent and only secondarily with the message itself, just as the packaging of toothpaste can affect sales in partial independence of the quality of the toothpaste inside. (Chafe 1976:28)

As a first illustration of how information packaging affects natural language interpretation, consider (1):

(1)   a. He hates CHOCOLATE.

b. He HATES chocolate.

c. Chocolate he LOVES.

In (1), (a) and (b) are truth-conditionally equivalent. They differ not in what they say about the world, but in how they say what they say about the world, i.e., they differ in the way their content is packaged. Compare now (b) and (c): they differ in their truth conditions, but exude a certain interpretive equivalence, which is a result of the fact that they are packaged in the same way. In other words, (b) and (c) differ in what they say about the world, but not in how they say it. In every language there is an array of sentences which, like (1a) and (1b), differ only in the way they are packaged. However, these alternatives cannot be used interchangeably in context. This can be empirically confirmed in terms of discourse felicity. For instance, while (1a) is a felicitous answer to the question *What does he hate?*, (1b) is not.

The partition of sentences into a focus-ground (also known as focus-topic, rheme-theme, new-given) plays a central role in information packaging (see Sgall & hajiçová, Halliday 1985,

As suggested by Clark & Haviland (1977:5), the point of such a partition is to optimise the communicative process. Vallduví 1992 contains a partial formalisation of information packaging which takes up on these traditional ideas on focus-ground with the aim of establishing a first step towards an implementation in a dialogue-modeling system. The different packagings illustrated in (1) are viewed 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 or as different ways of effecting information update. Each instruction-type—there are four of them—corresponds to a different ground-focus partition.

The *focus* is defined as the actual information or 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. The *ground*, in contrast, is already subsumed by the input information state and acts as an usher for the focus: it guarantees the appropriate attachment or anchoring of the information in the hearer's information state. 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. The four instruction-types are the result of different combinations of focus, link, and tail.

In order to understand how instructions work, let us view information states as file-like constructs (see Heim 1983). Files are collections of file cards. File cards correspond to what are called discourse referents, entities, or markers in other frameworks. Each file card has a number of records—analogous to conditions in Discourse Representation Theory (Kamp & Reyle 1993)—written on it listing descriptions (attributes and relations) that concern the entity it denotes. Given this background, the ushering function of the ground is described as follows. The link of a sentence S, on the one hand, establishes a particular file card as the locus of update. This means that the information conveyed by the focus of S is to be recorded on the file card denoted by the link (cf. Kuno's (1972) 'sort key', Chafe's (1976) 'frame', and Reinhart's (1982) 'address'). We can express this by saying that, if an expression denoting a file card fc is structurally encoded as a link, then it is informationally interpreted as GOTO(fc). As noted, the role of a link is to *establish* a locus of update. Therefore, if the locus of information update for S_n is inherited from S_{n-1}, no link is required for S_n and we obtain a linkless instruction. The tail, on the other hand, points at a particular (possibly underspecified) record on fc. If a tail is present, the information conveyed by the tail is taken to modify (or further specify) the record designated by the tail. Tailless instructions

correspond to a default mode of update (UPDATE-ADD), where the update potential of S is merely added to fc in the input file as a record. The presence of the tail indicates that a nondefault mode of update (UPDATE-REPLACE), involving further ushering, is (in the speaker's eyes) required.[2]

The four instruction-types reflect the combination of the two modes of update with the establishment of a locus of update or the absence of such establishment:

(2) link-focus   ⟶   GOTO(fc)(UPDATE-ADD(*information*))
     link-focus-tail   ⟶   GOTO(fc)(UPDATE-REPLACE(*information,record(fc)*))
     all-focus   ⟶   UPDATE-ADD(*information*)
     focus-tail   ⟶   UPDATE-REPLACE(*information,record(fc)*)

The link-focus instruction designates a locus of update in the hearer's information state and indicates that the update is to be carried out by adding a record on this locus of update with the information conveyed by the focus. The link-focus-tail instruction designates a locus of update too, but in addition it designates a particular record on the file card that acts as locus of update and indicates that the update is to be carried out by completing or modifying this record with the information conveyed by the focus. The two linkless instructions parallel these two types, except that the absence of a link here means that the locus of update is inherited rather than designated. These four instruction-types systematically all the informational constructions previously described in the literature from the topic-comment, ground-focus, and other perspectives. UPDATE-REPLACE instructions correspond to the so-called narrow-focus sentences or to a typical open-proposition structure in Prince 1986. Link-focus instructions correspond to the typical topic-comment structure or to a standard categorical judgment (Kuroda 1972). Finally, a subset of the all-focus instructions corresponds to the neutral descriptions of Kuno 1972, the news sentences of Schmerling 1976, or to a thetic judgment.

It follows from the way the informational primitives are defined that the focus-ground partition of a simplex sentence is composed of discrete units that do not overlap. In other words, every element must be associated with a focus, link, or ground interpretation. 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. 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. Also, every nonweak element in a sentence must contribute to its information structure.[3] This follows from the assumptions that in every sentence there is a focal segment

[2] The description 'nonweak elements' is meant to exclude weak proforms. Weak proforms (null pronouns and pronominal clitics in Catalan and unstressed pronouns in English, among other forms) do not participate in the construction of instructions (see Vallduví 1992 for arguments in favour of this position). Strong proforms are nonweak.

[3] The file metaphor and the idea of a designated file card is also used by Erteschik-Shir. Her idea of a designated file card, however, is distinct from, although not totally unrelated to, our use of designated file card as loci of update and is closer to the notion of 'topic' in Givón 1983 or the idea of 'focus' (unrelated sense) in Sidner 1983. Erteschik-Shir's comprehensive proposal covers aspects of informational focus in its relation to syntax, prosody, and semantics.

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.

Let us illustrate the use of these instructions with a concrete English example. Consider (3) and (4). S_0 is a presidential aid, H_1 a newly-appointed White House butler, and H_2 the Foreign Secretary after returning from a trip to Europe. In these examples and below, foci are delimited by square brackets, small caps represent a focus-associated A-accent (nuclear stress), and boldface indicates the link-associated B-accent of English. 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*). We will return to the facts concerning realisation in Section 3:[4]

(3) a. H_1: So tell me about the people in the White House. Anything I should know?

   b. S_0: Yes. The **president** [F hates the Delft CHINA SET]. Don't use it.

(4) a. H_2: In the Netherlands I got a big Delft china tray that matches the set in the living room. Was that a good idea?

   b. S_0: Maybe. The **president** [F HATES] the Delft china set.
      (but the **first lady** LIKES it.)

The update potential of (3b) and (4b) is *not* the same. This is because the H_1's input information state (let us call an input information state a file F_1) in the scenario of (3) differs from H_2's F_1 in the scenario of (4). From both contexts it can be inferred that both H_1 and H_2 know about the people in the White House including the president, the Delft china set, and about the president owning the latter. However, in (3) S_0, the presidential aid, has no reason to assume that the hearer, H_1, has any beliefs about (and is attending to) the president's attitude towards the Delft china set. H_1's question, *Anything I should know?*, could have been given a number of equally relevant, felicitous answers: that the president does not like fish, that the president always eats at nine o'clock, that he has high cholesterol, that he eats in the Oval Office, and so on. In contrast, in (4) S_0 is warranted to assume, given what she has heard in the immediately previous dialogue, that H_2 believes (and is attending to) that the president has some attitude towards the Delft china set (perhaps without knowing which one it is). Using Jackendoff's (1972) words, the president's having some attitude towards the Delft china set is 'under discussion' at the time of utterance in context (4) but not in context (3). This means that $F_1(H_1)$ at the time (3b) is uttered contains less information than $F_1(H_2)$ at the time (4b) is uttered. The difference in informativeness or update potential between (3b) and (4b) is determined by the contents of the input files that they can felicitously augment. Nevertheless, both (3b) and (4b) express the same propositional content, namely that the president hates the Delft china set. The truth-conditional identity of these sentences is reflected in the fact that they yield the same output information state. The output information state (F_2) for H_1 and H_2 is exactly the same. Both $F_2(H_1)$ and $F_2(H_2)$ contain the information that the

[4]In the following examples, both *china* and *set* have been written in small caps, because there is inter-speaker variability in the assignment of stress to the phrase *china set*. Some speakers treat it as a compound and, therefore, stress *china*. Others do not and stress *set*.

predident hates the Delft china set. 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.

The difference in update potential between (3b) and (4b) is reflected in their structure. In (4b), for instance, where the president's having some attitude towards the Delft china set is treated as being believed and attended to by the hearer, a structure is chosen that singles out the verb *hates* as the only informative part of the sentence, while *the Delft china set* is treated as part of the ground. In (3b), where no such assumption is warranted, another structure is used that indicates that the entire verb phrase is focal. As discussed below, example (3b) encodes a link-focus instruction and example (3a) encodes a link-focus-tail instruction. In the case of (3b) and (4b), the structures utilised to realise the difference between the UPDATE-ADD instruction and the UPDATE-REPLACE instruction are intonational structures. In addition, both (3b) and (4b) indicate that *the president* is a link, i.e. they establish the file card for the president as the locus of update. In English, this function is also carried out intonationally. The exact nature of these intonational realisations is discussed in Section 3.

3 Linguistic realisation

The characterisation of informational primitive and instruction-type outlined in Section 2 is independent of how a particular instruction-type is realised in particular languages. In fact, the structural realisation of these instruction-types differs from language to language. All structural dimensions—intonation, syntactic precedence, and morphological marking—are susceptible of being exploited by information structure.

Let us look at how English and Catalan realise the three informational primitives (focus, link, and tail) and the instruction-types they combine into. Compare the English realisations discussed in (3) and (4), repeated in (5), with their Catalan analogues in (6). The (a) sentences are link-focus instructions, while the (b) sentences are link-focus-tail instructions:

(5) a. The **president** [F hates the Delft CHINA SET.]

   b. The **president** [F HATES] [TAIL the Delft china set.]

(6) a. El president$_1$ [F odia el joc de porcellana de DELFT t$_1$.]

   b. El president$_1$ [F l$_2$'ODIA t$_2$ t$_1$,] [TAIL el joc de porcellana de Delft$_2$.]

We observe two differences. One, we see that there is no syntactic contrast between the two English sentences. The only contrast is intonational: in the link-focus sentence nuclear stress (the A accent) appears on the right-hand periphery of the clause, whereas in the link-focus-tail sentence it appear sentence-medially, entailing the deaccenting of the tail *the Delft china set*. In Catalan, however, a syntactic opposition exists: in the link-focus sentence, the focal object appears in its canonical position within the sentential core, whereas in the link-focus-tail sentence, the tail object appears in a peripheral detachment slot (this dependency is indicated by the coindexing of the detached object and the canonical position t in (6)).[5] At

[5]There are a number of diagnostics used to determine the peripheral status of the object. The clearest one

first blush, there appears to be an intonational contrast as well, but on closer inspection it becomes clear that nuclear stress is assigned to the same position—the right-hand boundary of the sentential core—in both sentences. The second difference between English and Catalan has to do with the realisation of links. In the English sentences the link phrase *the president* appears in boldface, which indicates that it is associated with a B accent. In Catalan, in contrast, there is no B accent associated with the link phrase. Rather, the link appears in a peripheral detachment position as well.[6]

English and Catalan vary in their structural realisation of information packaging along two important lines: whether the language has a malleable intonational structure—intonational plasticity (Vallduví 1991)—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

The conclusion derived from the comparison of (5) and (6) is that, when it comes to realis- ing information packaging, where English uses intonational strategies, Catalan uses syntactic strategies. English has a malleable intonation. This contrasts with the nonplasticity of Cata- lan. In Catalan nuclear stress necessarily falls on the right-hand boundary of the sentential core. It cannot be 'shifted' to the left. In addition, English uses a richer repertoire of accents than Catalan, since it exploits both A and B accents. The A accent is exploited by both languages and associated with a focal interpretation, but the B accent is exploited in English to realise links. The contour formed by a B accent followed by an A accent seen in (5a) is called the 'suspension bridge contour' by Bolinger 1961 and the 'hat pattern' by Cohen & 't Hart 1967. Catalan does not possess a B accent. Links display no particular intonational prominence. Instead, what identifies them is that they are obligatorily left-detached. Pre- cisely, Catalan is characterised by the necessary placement of nonfocal phrases in right- or left-detachment slots: links, as just noted, are left-detached and tails, as illustrated in (6), are right-detached. The sentential core may contain only focal phrases. Phrases (arguments or adjuncts) which, due to default string order, would otherwise appear in the rightmost position, must be removed from that position if in association with an A accent is inappropri- ate, namely, if they are nonfocal. Left-hand placement of the link is also available, albeit

is the presence of a clitic bound by the detached complement. Coocurrence of clitic and complement within the sentential core is illicit, but a clitic must be present if the complement it stands for is outside the sentential core (or not present at all). Other diagnostics involve string order and placement of particles.

[6] Since Catalan lacks subject clitics, the clitic diagnostic cannot be used for the subject *el president*. However, the other diagnostics agree with the detachment analysis. In addition, it has been convincingly argued on independent grounds that Catalan is a VOS language and that subject links in examples like (6a) and (6b) appear ina left-hand position (see Rosselló 1986, Rigau 1988, Bonet 1990, Solà 1992, and Vallduví 1993)

optional, in English. However, its application on a given phrase does not preempt its being B-accented, which shows B-accenting is the necessary correlate of linkhood (as an exception, subject links may in some cases appear without any intonational marking; nonsubject links, whether fronted or in situ, must be B-accented).[7]

The description of the English intonational facts, qua structural correlates of information packaging, that we have just offered 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, semantic or metalinguistic aspects of interpretation may override the default prosodic realisation of foci and links. See, for instance, the L*+H accent associated with speaker uncertainty (Ward & Hirschberg 1985), the uses of intonation to express illocutionary distinctions (Pierrehumbert & Hirschberg 1990), the (de)accenting phenomena that affect the assignment of pitch accent at the phrasal and word-internal level within both focus and link (Ladd 1980, 1983, van Deemter 1994, Vallduví & Zacharski 1994), and the 'super-utterance prosodic assignments' due to conversational context or nature of the exchange within which a sentence is uttered (Kowtko, Isard & Doherty 1992, Kowtko 1992). Finally, it is perhaps more appropriate to speak about focus- and link-associated tunes rather than focus- and link-associated pitch accents (Ladd 1991, Steedman 1991).

Summarising this section, informational primitives are correlated with different struc- tural realisations in Catalan-type and English-type languages. In the former the structural correlates are syntactic, involving both dominance (detachment) and precedence (left- versus right-detachment). In the latter the structural correlates are intonational, involving two types of accent.[8]
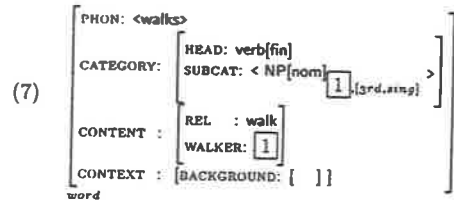
4 An HPSG analysis

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 struc- ture 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 infor- mation 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.[9]

[7] 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, 1995 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.

[8] There is an important language-type which is not represented in Table 1 at all: languages that make use of morphemes to realise information packaging. In languages like Navajo (Schauber 1979) and Ute (Thwing and Watters 1987), for instance, foci are associated with a particular morpheme, and Japanese *wa* (e.g. Kuno 1972) can be straightforwardly characterised as a marker of linkhood.
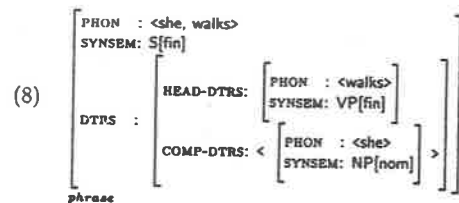
[9] Several proposals exist that explore the integration of focus-ground into an explicit syntax (a choice of frameworks: Culicover & Rochemont 1983, Rochemont 1986, Oehrle 1991, Steedman 1991, Erteschik-

In HPSG the relevant units of linguistic information are *signs* (Pollard & Sag 1987, 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 (7) is the lexical sign for *walks*:

$$
(7) \quad
\begin{bmatrix}
\text{PHON: } \langle \text{walks} \rangle \\
\text{CATEGORY: }
\begin{bmatrix}
\text{HEAD: verb[fin]} \\
\text{SUBCAT: } \langle \text{NP[nom]} \boxed{1}_{[3rd.sing]} \rangle
\end{bmatrix} \\
\text{CONTENT: }
\begin{bmatrix}
\text{REL} : \text{walk} \\
\text{WALKER: } \boxed{1}
\end{bmatrix} \\
\text{CONTEXT: } [\text{BACKGROUND: } [\quad]]
\end{bmatrix}_{word}
$$

The value of PHON in Pollard & Sag 1994 is simply an orthographic representation of the corresponding lexical item, e.g. walks. The feature CATEGORY provides information about the inherent and combinatorial properties of a word.[10] The CONTENT feature contains information about aspects of semantic interpretation which are assumed to be context-independent. Finally, CONTEXT 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 (7) there is structure sharing between the value in the SUBCAT feature in CATEGORY and the argument of WALKER in CONTENT. Structure sharing is indicated by the identity of the boxed tags.[11]

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:

$$
(8) \quad
\begin{bmatrix}
\text{PHON} : \langle \text{she, walks} \rangle \\
\text{SYNSEM: S[fin]} \\
\text{DTRS: }
\begin{bmatrix}
\text{HEAD-DTRS: }
\begin{bmatrix}
\text{PHON} : \langle \text{walks} \rangle \\
\text{SYNSEM: VP[fin]}
\end{bmatrix} \\
\text{COMP-DTRS: } \langle
\begin{bmatrix}
\text{PHON} : \langle \text{she} \rangle \\
\text{SYNSEM: NP[nom]}
\end{bmatrix}
\rangle
\end{bmatrix}
\end{bmatrix}_{phrase}
$$

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.

Shir, to appear. Phonologist have also addressed the issue of how intonational structure signals focus-ground articulation (e.g. Gussenhoven 1983, Ladd 1983, Selkirk 1984, von Stechow & Uhmann 1986, Bird 1991).

[10]There is important recent work on the expression of phonological information in typed feature structures. The PHON field is enriched to contain multi-tiered, hierarchical representations.

[11]CATEGORY and CONTENT are normally grouped into a single feature dubbed SYNSEM. Here we will retain a flat sign structure.

These schemata specify that these signs must have a head daughter and a variable number of complement daughters:

(9) *Head-Complement Schema*
The SYNSEM|LOCAL|CATEGORY|SUBCAT value is a list of length one, and the DTRS value is an object of sort *head-comp-struc* whose HEAD-DTR value is a word.
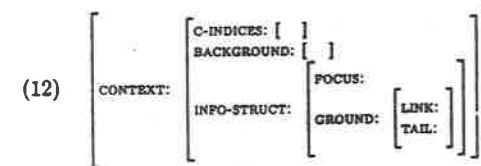
(10) *Head-Subject Schema:*
The SYNSEM|LOCAL|CATEGORY|SUBCAT value is <>, and the DTRS value is an object of sort *head-comp-struc* whose HEAD-DTR value is a phrase..., and whose COMP-DTRS value is a list of length one.

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) statements. Precedence follows the obliqueness hierarchy of complements (among complements, the most oblique argument is the rightmost one). Phrasal signs can also be represented in tree notation. The tree in (11) is equivalent to feature structure (8):

(11)

```
              S[fin]
            C /    \ H
       NP[nom]      VP[fin]
          |            |
         she         walks
```
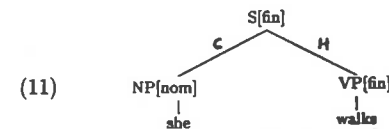
DTRS information appears at the end of the labelled arcs. These arcs are labelled H for head daughter and C for complement daughter. The PHON values for each lexical sign are written at the leaf below each daughter node. The rest of the information appears in the node labels.

Where should information structure be located in such multidimensional representations? Karttunen & Kay 1985, for instance, use 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. Rather, they favour an independent representation of information-packaging information within the CONTENT or CONTEXT features. 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 (12), corresponding directly to the informational primitives introduced in Section 2:

$$
(12) \quad
\begin{bmatrix}
\text{CONTEXT: }
\begin{bmatrix}
\text{C-INDICES: } [\quad] \\
\text{BACKGROUND: } [\quad] \\
\text{INFO-STRUCT: }
\begin{bmatrix}
\text{FOCUS: } \\
\text{GROUND: }
\begin{bmatrix}
\text{LINK: } \\
\text{TAIL: }
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

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 the individual languages. 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.

4.1 English

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 (13a) and (13b):

(13) (a) [1] [PHON|ACCENT: A] [INFO-STRUCT|FOCUS: [1]] *word* (b) [1] [PHON|ACCENT: B] [INFO-STRUCT|GROUND|LINK: [1]] *word*

The structure in (13a) is a skeletal lexical sign which says about itself that it contributes focal 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. And vice versa, the focal or link status of a lexical sign is sufficient to determine the value of its ACCENT. The principles in (13) express only a mutual constraint between ACCENT and INFO-STRUCT. Ultimately, what determines what the values of these features are is (the speaker's view) of the hearer's information state at the time of utterance.

Not all lexical items in a sentence, however, are associated with one of these accent types. Therefore, we need a third type of lexical sign as in (14):

(14) [PHON|ACCENT: u] [INFO-STRUCT: [ ]] *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.[12]

As noted above, phrasal signs are licensed by the relevant ID schema. We propose that, in addition, phrasal signs in English must satisfy the INFO-STRUCT instantiation constraints given in (15). These two constraints capture, respectively, the inheritance and projection of INFO-STRUCT values in English.

[12] The precise way in which unspecified information is represented will not be addressed. An option is to use disjunctive values. See Mandar 1994a for an alternative proposal involving a hierarchy of values. A fully worked out description of intonation would, of course, have to work on real tones (rather than the mnemonic categories A and B that we use here) and worry about how tunes and intonational phrases are composed (see Bird 1991, Taglicht 1994). The notation we use, while phonologically inadequate, is sufficient to express the multidimensional constraints we are concerned with here.

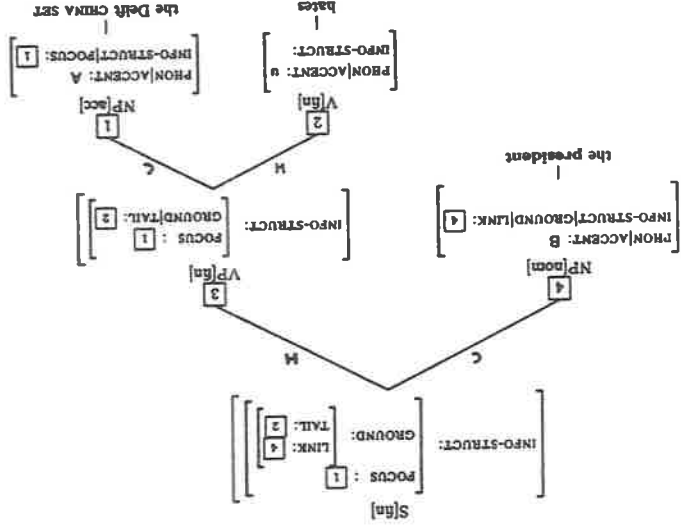(15) INFO-STRUCT *instantiation principles for English:*

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 (16). 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):

(16) The president [F hates [F the Delft CHINA SET.]]

Some contexts require string (16 to have a narrow-focus reading. The narrow focus reading is licensed by (15i) (focus inheritance), while the wide focus reading is licensed by (15ii) (focus projection).[13] The sign for the narrow focus case is as in (17) (we omit many aspects of the sign that are irrelevant here):

(17) *Object NP focus:*

S[fin]
  INFO-STRUCT: [FOCUS : [1] GROUND: [LINK: [4] TAIL: [3]]]

  C NP[nom] [4] the president [PHON|ACCENT: B] [INFO-STRUCT|GROUND|LINK: [4]]

  H VP[fin] [3] INFO-STRUCT: [FOCUS : [1] GROUND|TAIL: [3]]

      H V[fin] [2] hates [PHON|ACCENT: u] [INFO-STRUCT: u]

      C NP[acc] [1] the Delft china set [PHON|ACCENT: A] [INFO-STRUCT|FOCUS: [1]]

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 (13), their signs structure-share with the values of the LINK and FOCUS features, respectively. In the tree notation, the

[13] The application of inheritance or projection is, of course, ultimately determined by the context at the time of utterance. The INFO-STRUCT instantiation principles are just the grammatical mechanism that allows the same string to have one meaning or the other in different contexts.

value of e.g. LINK in (17) 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 (14)).

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 (15i): 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 (15i): the object is the focus, the verb is a tail, and the subject is a link.

In some other contexts, string (16) will be required to have a wide-focus reading. The structure for the wide focus reading is given in (18). It is identical to (17) except for the instantiation of the FOCUS value in the VP[fin] and S[fin] signs. Here, projection as in (15ii) 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 (18):

(18)   *VP focus:*
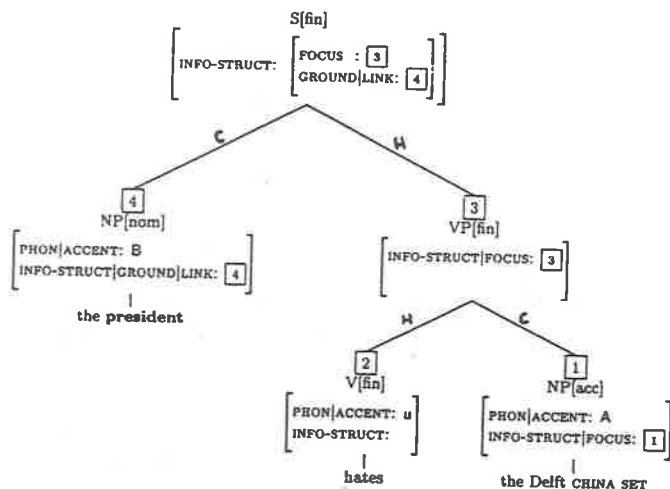
As is well known since Bresnan 1971, focus projection is only possible if the A accented item is the peripheral one. In (15ii) this is captured by explicitly stating that the complement daughter whose FOCUS value is instantiated has to be the most oblique one. Principle (15ii) correctly allows a wide-focus reading in (19a), while ruling it out in (19b). Our grammar must disallow projection here, since (19b) is not felicitous in any context. The instantiation of the FOCUS value of *the president* in a string like (19b) allows only for inheritance, which is the narrow-focus reading in (19c):

(19)   a.   The butler [F offered the president some COFFEE.]

       b.   * The butler [F offered the PRESIDENT some coffee.]

       c.   The butler offered [F the PRESIDENT] some coffee.

The principles in (15) 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):

(20)   [F [F The PRESIDENT] called.]

Focus projection, i.e. the all-focus interpretation, is correctly licensed. Principle (15ii) may apply because the subject is the only complement daughter of S[fin] and, hence, the most oblique one.

Principle (15ii) 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 (21) in which the A accent is associated with the verb rather than a complement. The structure of (21) is shown in (22):

(21)   The president [F HATES] the Delft china set.
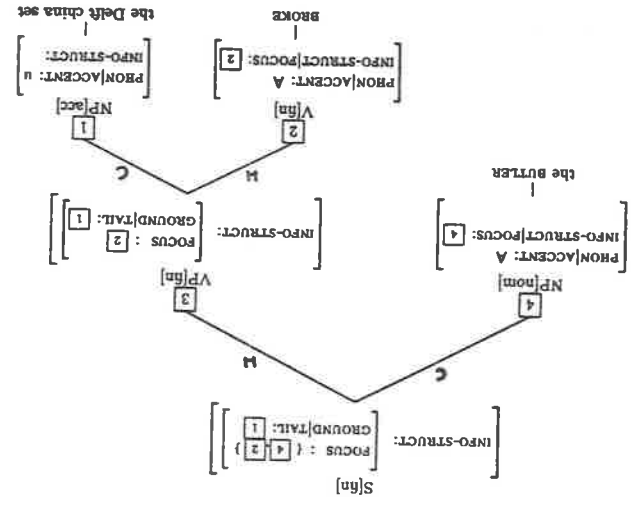
(22)   *Verb focus:*
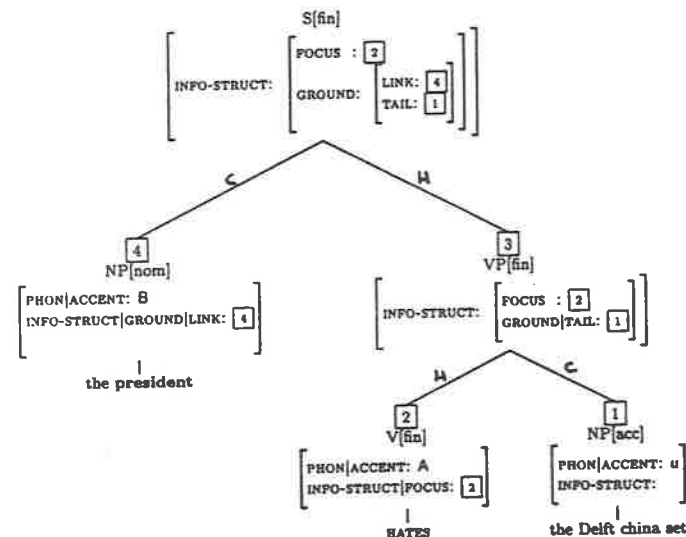
Here the value of FOCUS in VP[fin] is obtained via inheritance from the head daughter. There is no option for projection. Principle (15ii) cannot apply because no complement daughter of VP[fin] has an instantiated INFO-STRUCT|FOCUS feature. Instead the values of INFO-STRUCT are obtained via (15i). As a consequence, as in example (17) 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 (23) there is no focus projection:

According to Krifka, example (26) also gives rise to a wide-focus reading. The instantiation principles in (15) correctly allow for this, since the instantiated FOCUS of NP[dat] can undergo projection.[15]

Example (28) is an adapted version of Steedman's (1991:283) example (54). Sentence (28) is parallel to (24) above but for one thing: even though the verb is part of the focus, there is no pitch accent on it:

(28)   [F FRED ate] the beans.

A sentence of this type is problematic for our approach because, without the association of the verb with an A accent, it is impossible to recover its focal value. However, such strings are only possible when the verb is highly predictable or uninteresting (see Bolinger 1989, Zacharski 1993) and even then, as Steedman himself admits (1991:283) the accented version represents an improvement over the unaccented one (e.g. a version of (24) with an unaccented *broke* is not viable). In light of these facts, we suggest that in examples like (28) we are witnessing the effects of an independent process of deaccenting (see Section 3). This view appears to be in harmony with the phonological evidence (Bob Ladd, personal communication). How to express the phenomenon of deaccenting in a declarative framework like HPSG is an important issue that has to be addressed but remains outside the scope of our research.

4.2   Catalan

Let us now turn to Catalan. As noted, in Catalan informational interpretation is signalled by syntactic position rather than by accent type. Examples (29) to (31) illustrate the particular pattern found in Catalan. Every (nonweak) phrase within the sentential core is interpreted as focal. In (29) the string verb+oblique+subj is the focus of the sentence:

(29)   Ahir   [F 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 detached away from the sentential core. This configuration is called clitic-dislocation in Cinque 1990. This is the case with the locative in (30) and the subject in (31):

(30)   a. A Barcelona$_1$ [F hi$_1$ va tornar t$_1$ el PRESIDENT.]
       b. [F Hi$_1$ va tornar t$_1$ el PRESIDENT,] a Barcelona$_1$.

(31)   a. El president$_1$ [F va tornar a BARCELONA t$_1$.]
       b. [F Va tornar a BARCELONA t$_1$,] el president$_1$.

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 (30) and (31) is in the ground informational contribution the

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[15]If *John* in (26) were not a link, one could answer the same (or similar) question with a sentence in which *Bill* was a (B-accented) link and *Mary* an A-accented focus. This is quite common when answering multiple wh-questions and has been noted for a number of languages (see Kuno & Robinson 1972). In such an event, of course, the answer in question is not a multiple or complex focus sentence.

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 INFO-STRUCT|GROUND value is instantiated:[16]

(32)   *Head-Dislocation Schema for Catalan:*
       The DTRS value is an object of sort *head-disloc-struc* whose HEAD-DTR|SYNSEM|LOCAL| CATE-GORY 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.[17]

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:

(33)   LP constraint on INFO-STRUCT instantiation in Catalan:
       LINK > FOCUS > TAIL

The LP statement in (33) states that link must preced foci and that foci must precede tails. Thus 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-STRUCTFOCUS in the core S[fin] sign is always itself. With this proviso, it is easy to see that Catalan makes use only of inheritance (15i). 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 (34), which corresponds to the link-focus example (6) in Section 1, illustrates a left-detachment structure where the DISLOC-DAUGHTER is interpreted as a link:

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[16]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. The adjunction-to-S analysis of Romance detachment is found in Rochemont 1989 and Vallduví 1992. See also Sanfilippo 1990 for a different proposal within a Unification Categorial Grammar.

[17]This binding relation covers both coreference and subsumption (see Dorrepaal 1994)

(34) *Clitic left-dislocation:*

S[fin]
$$\text{INFO-STRUCT:}\begin{bmatrix}\text{FOCUS} & : & [1]\\ \text{GROUND|LINK:} & & [2]\end{bmatrix}$$

M   DISLOC

S[fin] [1]   NP[nom] [2]
[INFO-STRUCT|FOCUS:[1]]   [INFO-STRUCT|GROUND|LINK: [2]]

odia el joc de porcellana de Delft t_1 el president₁
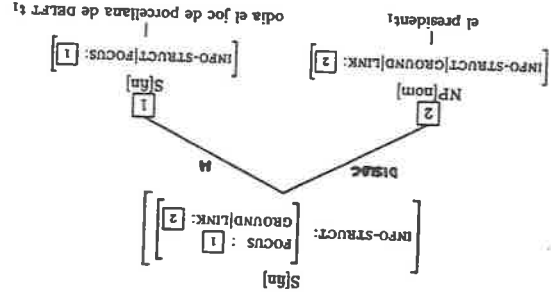
The entire head daughter, i.e. the sentential core, is the FOCUS value of the top S[fin]. The LINK value of the top S[fin] is inherited from the left-detached daughter.

A case of simultaneous left- and right-detachment is given in (35), which corresponds to the link-focus-tail example in (6). 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.

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

S[fin]
$$\text{INFO-STRUCT}\begin{bmatrix}\text{FOCUS} & : & [1]\\ \text{LINK:} & & [2]\\ \text{TAIL:} & & [3]\end{bmatrix}$$

DISLOC-1   M   DISLOC-2

NP[nom] [2]   S[fin] [1]   NP[acc] [3]
[INFO-STRUCT|LINK: [2]] [INFO-STRUCT|FOCUS: [1]] [INFO-STRUCT|...|TAIL: [3]]

el president₁   l₂ odia t_3 t_1 el joc de porcellana de delf₂
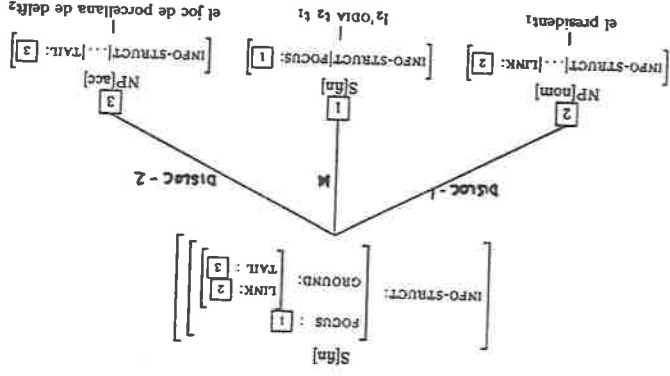
We have expressed the relationship between intonation and information structure in English by simultaneously specifying the ACCENT and INFO-STRUCT values and by subjecting them to the instantiation principles in (15). In Catalan the information-packaging contribution of a phrase is determined by its 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.

5 Other approaches

Steedman 1991 proposes an integration of information structure into grammar using a Combinatory Categorial 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 (21) where the ground is made up of discontiguous segments, we consider this a positive feature of the HPSG analysis.

As noted in Section 1, linkhood is associated in English with a B accent 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.

The proposal in Vallduví (1992:115-138) 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 θ-structure and LF is a representation of operator-variable relations. Which level should information-packaging relations be represented at? In this proposal the mapping between information packaging and the structural components through which it is realised is 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 intepretive 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, within the GB proposal we are now discussing, 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 possible are confined to PF and S-structure. In the proposal under discussion, at IS all ground elements must move to designated slots outside the sentential core, thus yielding disambiguated structures. For instance, example (16) 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.

# 6 Information structure and content

In the analysis presented in Section 4 information structure is represented in the CONTEXT field rather than the CONTENT field. In effect, this means that information structure is viewed, in principle, as independent of the truth-conditional dimension of meaning. This view of informational structure as essentially a communicative dimension is not universally shared. There have been several recent attempts to fold informational notions into the logico-semantic component (see von Stechow 1981, 1991, Rooth 1985, 1992, Kratzer 1991, Partee 1991, Krifka 1991-92, 1992).

While it is true that the information structure of sentences interacts with a number of quantificational elements in an interesting way, we believe that such interaction must be represented in the grammar in a modular way. The separate representation of INFO-STRUCT and CONTENT is intended to capture this belief. Of course, taking this approach means that, at some point, we must undertake the task of describing how the interaction between information structure and the logico-semantic content is effected. The issue is currently under investigation and not much will be said about the specifics of the analysis here. Instead, this section discusses the empirical motivation for an architecture where information structure and logico-semantic content are represented in a modular way.

In a number of recent papers the focus-ground partition has been analysed as a determi-

nant of quantificational partition, where the focus identifies the nucleus (nuclear scope) of an operator and the ground identifies its restrictor (Partee 1991, Krifka 1992):

(36) Tripartite quantificational structure:
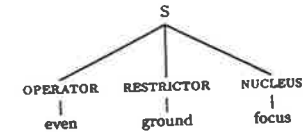
The stimulus for such an approach is the behaviour of so-called focus-sensitive operators (e.g. *even*, *only*, quantificational adverbs, negation, modals). Jackendoff (1972:248), among others, notices that sentences (37a-c) cease to be equivalent in propositional content in the presence of these focus-sensitive operators (38):

(37) a. What did John do?
          John [F gave his daughter a new BICYCLE].

      b. What did John give his daughter?
          John gave his daughter [F a new BICYCLE].

      c. Who did John give a new bicycle?
          John gave [F his DAUGHTER] a new bicycle.

(38) a. John even [F gave his daughter a new BICYCLE].

      b. John even gave his daughter [F a new BICYCLE].

      c. John even gave [F his DAUGHTER] a new bicycle.

The VP-external adverb *even* in (38a-c) is interpreted as being construed with, i.e. as associating with, the constituents enclosed in brackets. Having identified the bracketed constituents as foci, Jackendoff concludes that *even* associates with focus. Thus, configurations where the nucleus of an operator coincides with the focus of the sentence have been called instances of 'association with focus'.

From the aforementioned recent semantic perspective, the primary function of focus-ground is to provide a quantificational structure for these focus-sensitive operators. The communicative use of focus-ground is merely one of the uses this quantificational structure serves (assuming there is a covert focus-sensitive communicative operator akin to ASSERT in Jacobs 1984). Given this view of focus-ground it is actually imperative that focus-sensitive operators take focus-ground partitions as arguments, since they crucially depend on the structure provided by focus-ground to express their meaning. This type of analysis makes two predictions. First, it predicts that the quantificational structure of a focus-sensitive operator is *always* homomorphic to the focus-ground articulation of the sentence, and, second, it predicts that simplex sentences with more than one focus-sensitive operator contain multiple focus-ground partitions (overlapping or recursive), something which is at odds with the

tradicional view of focus-ground.[18] On the one hand, it is well known that some operators, e.g. negation, display optional association with focus. Thus, example (39c), with a focal *because*-phrase, can be an answer to both (39a) and (39b). In the association-with-focus reading of (39c) admits to having done something while negating that the querier was the reason for her doing it. In the reading where negation does *not* associate with focus—it remains in the ground—the utterer of (39c) simply provides a reason for why she did not do whatever she did:

(39) a. Why did you do it?
b. Why didn't you do it?
c. I didn't do it [F because of YOU].

On the other hand, there are clear mismatches of quantificational partition and focus-ground even with strongly focus-sensitive operators. Example (40), where the verb phrase is focal, is a case in point involving the quantificational adverb *often*:

(40) Scandinavians often [F win the Nobel PRIZE.]

In (40) the focus should provide the quantificational nucleus and the ground should provide the restrictor. If this were so, (40) would mean that, given those situations/times in which Scandinavians do something (among a relevant set of alternatives), this is often winning the Nobel prize. While this is a marginally possible reading in some contexts, it is not the most accessible reading of (40). Rather, what (40) means is that given those situations/times in which someone wins the Nobel prize, it is often Scandinavians. The quantificational nucleus is provided by *Scandinavians*, a ground element, and the restrictor is provided by the informational focus. Similar observations can be made about Westerståhl's (1985:403) original example, which does not involve adverbial quantification but rather determiner quantification:

(41) Many Scandinavians [F have won the Nobel prize in LITERATURE.]

The meaning of (41) is that, out of all the people who have won the Nobel prize in literature, many are Scandinavians, precisely the reading where the focus acts as restrictor. If the focus were the nucleus, the meaning of (41) would have been that, out of all Scandinavians, many are Nobel prize winners, something which is blatantly false. This behaviour, quite unexpected from a perspective that focus-ground equates quantificational partition, is perfectly legitimate from a perspective where informational packaging and logico-semantic content may constrain each other as separate dimensions.

It is harder to check the validity of the second prediction—that all quantificational nuclei are foci and, thus, that simplex sentences may have multiple focus-ground articulations—because of disagreement on what exactly should count as focus or ground. Some analysts

[18] In even more recent work, Partee has taken a weaker position regarding the function of focus-ground with respect to quantificational partition. Focus-ground may be the source of nucleus and restrictor, but in some contexts nucleus and focus-ground may run orthogonal to each other. As will become evident in what follows, this is precisely our belief as well.

take accentedness to be a necessary and sufficient condition to identify a focus. Others judge it to be a sufficient condition but not a necessary one: it is argued that, even though simplex sentences with more than one focus-sensitive operator contain more than one focus, one of the foci may remain unaccented. The end result is that, on some occasions, we identify a constituent as focal uniquely on the basis of it being in association with a focus-sensitive operator.

The issue is discussed in Vallduví & Zacharski 1994, where the relationships between informational focus, quantificational nucleus, and intonational focus (pitch accent) are explored in detail. They show that quantificational nuclei can be informational foci, informational links, or even unaccented constituents within a larger focus. In addition, it is known that the focus-sensitive operators themselves may be focal or may be ground (Koktová 1987). The conclusion Vallduví & Zacharski 1994 arrive at is that quantificational partition is independent of focus-ground and that, therefore, the presence of more than one focus-sensitive operator in a simplex sentence does not entail the presence of more than one focus-ground articulation. It is true that quantificational partition and the focus-ground articulation are very often isomorphic, but unless their independence is maintained, the numerous examples where there is a mismatch between the two dimensions remain unaccounted for.

As we saw, in examples (40) and (41) the quantificational partition of the sentence is not provided by the focus-ground partition. Rather, the information about what should go into the restrictor and what should go into the nucleus comes from the more general context of utterance, probably knowledge about the world (e.g. about the Nobel prize competition, about the number of Scandinavians out there). The need to appeal to more general background knowledge is not restricted to this type of sentences, though. Take, for instance, an example like (42), based on a similar example in Schubert & Pelletier (1989:215):

(42) John always hits the target.

In (42) the quantification is restricted to events in which John is shooting, although there is no overt expression of this restriction in the sentence. Clearly, the restriction to events of this type, the *reference ensemble* in Schubert & Pelletier's terms, must be made available by previous context or by world knowledge. In all these examples we need to resort to a source other than focus-ground for the quantificational partition of the sentence.

The issue is whether this same source—whatever it is exactly—is what determines quantificational partition even in cases in which this partition is isomorphic with focus-ground. In other words, are cases in which the ground is the restrictor just a subset of the cases in which the restrictor is made available from context? If this is so, then the grammar should not require the identity of ground and restrictor, but rather support the generalisation that grounds possess the necessary attributes to be premium sources of quantificational restriction.

7 Conclusion

The view we have adopted from the outset is that informational packaging can be characterised as a set of language-independent instruction-types and that informational primitives are definable in independence of their realisation. Using these language-independent primitives and

instructions as analytic tools, it becomes evident that the range of crosslinguistic variation in the realisation of information packaging is quite substantial. We have focused on English-type languages, in which intonation acts as the primary structural dimension for the realisation of information packaging, and on Catalan-type languages, where this role is played by syntax (dominance and precedence relations).

We believe that a multidimensional sign-based grammatical framework like HPSG is optimally suited to provide a thorough description of the crosslinguistic facts in a principled manner. We have represented information packaging as an independent dimension within the sign, which is available at every single level along with all other dimensions. For English the mutual constraints between ACCENT and INFO-STRUCT were described without requiring mediation by syntax or isomorphy of intonational, informational, and syntactic constituency. For Catalan, we described the mutual constraints between syntactic position and INFO-STRUCT without needing to refer to the PHON feature at all. The same approach can be easily extended to cover languages that use a morphological strategy to realise focus-ground partitions. Information structure is treated as an independent dimension of the sentence which may be 'folded into' the prosody or the word order in different ways, depending on the language. Even though we have not proposed an explicit account of the relationship between information structure and some aspects of CONTENT, we did sketch out what requirements the mutual constraints between the two dimensions would have to meet.

Keeping information structure independent of prosody and syntax provides an explanatorily adequate means to capture the interpretative focus-ground identity of structurally dissimilar constructions in different languages, but there are additional advantages of a utilitarian nature. In multi-lingual applications, for instance, it would appear to be useful to be able to use high-level generalisations about instruction-types so that the appropriate correspondences could be established. In addition, given that information packaging is concerned with the process of updating the hearer's information state by linguistic means, the availability of these high-level generalisations should facilitate the interface between natural language processing tools such as a dialogue handler or a database query system and the general reasoning procedures that have to be assumed in order to model an NLP system.

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CONTROL AS PREDICATION

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1. Introduction

Treatments of control in the literature have ranged between purely syntactic and purely semantic. The syntactic approaches conceive control as a relation between two positions in the syntax (Chomsky:1981,1986; Manzini:1983; Koster:1984; among others). The semantic approaches maintain that control structures have no empty positions in the syntax, and control is viewed as a relation between an individual and a property (the embedded infinitive) mediated by an appropriate verb (Chierchia:1984,1985; Dowty:1985). This paper discusses control in nominals and demonstrates that certain control phenomena cannot be accounted for satisfactorily within either of these approaches. In particular the paper examines constructions of the type exemplified in (1) from Hebrew:

1.a. Ha-xomarim$_i$ nitanim le-zikuk   e$_i$ be-maabada.
    the-matter possible for-refining e in-lab
    it is possible to refine the matter in a lab.

  b. Ha-proyekt$_i$ kaSe   le-bicua e$_i$.
    The-project difficult for-completion e
    The project is difficult to complete.

  c. Yosi hevi   et ha-aronot$_i$ le-harkava   e$_i$ ba-mitbax.
    Yosi brought *ACC* the-cabinets for-installing e in-the-kitchen
    Yosi brought the cabinets to install in the kitchen.

I will demonstrate that the embedded nominals in (1) are complex event nominals as defined by Grimshaw (1990) and, hence, must obligatorily occur with their arguments in the syntax. This leads to the conclusion that the NPs headed by *zikuk*, *bicua*, and *harkava* contain an internal argument position controlled by an element outside the NP. The control relation in the examples in (1) is indicated by coindexing. The null argument inside the NP is understood as being controlled by the subject coindexed with it. I will show that in Hebrew structures that exhibit control of an internal argument surface as nominals, whereas structures that exhibit control of an external argument, or both, surface as infinitives, as illustrated in (2):