Cognitive characterisation of basic grammatical structures

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Abstract

We describe the role of morphosyntactic categories and syntactic dependencies in the process of semantically interpreting composite expressions. Special attention will be paid to the combinatorial properties conveyed by morphosyntactic categories such as nominals and verbs, as well as by syntactic dependencies like subject, direct object, or nominal modification. The semantic characterisation of these grammatical structures is based on cognitive abilities and abstract conceptualisations. This will provide us with theoretical arguments to review and extend some basic assumptions of Cognitive Grammar and related work.

1. Introduction

The main objective of this paper is to characterise in cognitive terms the mechanism underlying the semantic interpretation of composite expressions. In particular, we will describe how the morphosyntactic categories of the constituent expressions and the specific syntactic dependencies relating them are involved in the process of interpreting compositional meanings. For this purpose, we need to define the abstract semantic content associated with the grammatical objects embedded in composite expressions. More precisely, this paper will be focused on describing the semantic facet of both morphosyntactic categories like nouns, verbs, adjectives, etc., and syntactic dependencies like subject, direct object, modifier, and so on.

Our semantic characterisation of morphosyntactic categories will be mainly based upon two different linguistic approaches: cognitive linguistics (Langacker, 1987-1991; Wierbizcka, 1988; Hudson, 1990), and formal semantics (Chierchia and Turner, 1988). Morphosyntactic categories will be defined taking into account cognitive processes and abstract

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conceptualisations, regardless of specific information concerning ontological types such as physical objects, events, substances, states, etc.

The semantic characterisation of syntactic dependencies will not be independent of compositional notions such as "operation of elaboration" (Langacker, 1987), "blending" (Turner and Fauconnier, 1998), "co-composition" (Pustejovsky, 1995) and "constructions" (Goldberg, 1996). We assume, more precisely, that a syntactic dependency refers to a 2-place semantic operation that combines the meaning of two linguistic expressions with the aim of building a more precise meaning. Two properties of this semantic operation are analysed: On the one hand, it is argued that the two combined expressions co-operate to elaborate the meaning of the composite dependency (we call such a property "dynamic co-composition"). On the other hand, the compositional device is not driven by the subcategorisation constraints that one expression imposes on the other, but by the binary subcategorisation frame built by the external syntactic dependency. Consider for instance a verb and a noun related by the direct object dependency. It is broadly assumed that the interpretation of the composite is driven by the subcategorisation structure of the verb. On this basis, it is only the noun that fills the constraints imposed by the verb in that syntactic position. By contrast, we claim that the noun also imposes semantic constraints on the verb. In order to achieve a co-compositional interpretation, the direct object dependency is provided with a 2-place predicative structure, in which its two arguments, the verb and the noun, are semantically integrated.

The semantic characterisation of morphosyntactic categories and syntactic dependencies addresses the definition of a more specific version of compositionality. The meaning interpretation of a composite relies on the morphosyntactic categories of its constituent expressions, the lexical content they convey, as well as the semantic operation denoted by the syntactic dependency connecting them. These three semantic objects work together in order to elaborate the interpretation of composites. Yet, in order to simplify the analysis, our proposal will not account for the principles organising lexical meaning.[1] We will focus merely on the meaning of morphosyntactic categories and syntactic relations. We will set out the basic ideas concerning both the way morphosyntactic categories could be related to semantic conceptualisation, and the way syntactic dependencies could be perceived as compositional and dynamic objects driving the process of meaning interpretation. Let us examine briefly the notions of conceptualisation and compositional meaning.

1.1. *Conceptualisation of morphosyntactic categories*

Linguistic expressions convey both lexical and morphosyntactic information. Lexical

information provides notions, parameters and principles organising ontological classes such as artefacts, events, properties, substances, states, natural objects, etc. Morphosyntactic information, however, allows expressions to be grammatically codified by means of categories such as noun, adjective, finite verb, adverb, infinitive clause, participle, etc., regardless of their lexical content. It is broadly assumed that two expressions may carry different lexical contents while they can be codified by the same morphosyntactic category. For instance, two expressions categorised as nouns, 'car' and 'apple', can refer to different ontological classes: artefacts and natural objects, respectively. The reverse is also true. Two expressions may be morphosyntactically codified in different ways while they carry the same lexical content. For instance, even though 'red' can be codified both as an adjective ('red table') and as a noun ('the red of the table'), it keeps the same lexical content; that is, it refers to a specific colour. Likewise, 'running' can be codified either as a verb or as a noun, but it refers in both cases to the same ontological event. It seems to be obvious that we cannot make a direct mapping from morphosyntactic categories like verbs, nouns or adjectives and ontological classes such as events, discrete objects or properties. Rather, we conceive the morphosyntactic categories as the organising schemes on the basis of which ontological information is structured and configured.

1.2. *Compositional Interpretation*

The main point of interest in most semantic frameworks is centred on how the polysemic lexical content of linguistic expressions is determined and specified in the process of compositional interpretation. When interpreting a composite expression, the lexical meaning of the constituents is mutually restricted. This process of mutual restriction is called "co-composition" (Pustejovsky, 1995; Mineur and Buitelaar, 1996), and "sense dynamic construction" (Victorri and Fuch, 1996). Co-composition (or sense dynamic construction) is the process of generating the meaning of a complex expression by taking into account some aspects of the polysemic meaning of the constituent expressions. Indeed, the specific meaning related to the composite is the result of merging and blending into a higher order semantic structure the compatible semantic sub-structures related to the underspecified constituent expressions. In other words, generating the complex expression's meaning is a process in which the combined entities "co-operate" together to restrict and specify the polysemic information carried by each expression (Ramsay, 1994; Gamallo2002).

In particular, we will define a syntactic dependency between a head and its modifier as a semantic operator that dynamically builds two kinds of subcategorisation restrictions: On the one hand, the head requires the modifier to fit some specific semantic constraints, and on the

other, the modifier also requires the head to fit specific restrictions. This 2-place subcategorisation structure is elaborated taking into account some aspects of the lexical content of the constituent expressions. Hence, unlike standards frameworks in compositional semantics, none of the two constituents imposes a pre-defined specific subcategorisation frame. We argue that this must be built dynamically during the interpretation process.

Let us consider the indeterminacy conveyed by the verb 'to load' and the noun 'book'. The verb leads to, at least, two different event interpretations: *bringing an object into a place* ('Ann loaded the hay onto the truck'), and *changing the state of a place* ('Ann loaded the truck with the hay'). The noun also seems to refer to two types of entities: *physical objects* (e.g., 'rectangular book'), and *symbolic entities* (e.g., 'naive book'). Yet, the interpretation of the composite expression 'to load the books' involves the elaboration of a specific content of both constituents. The verb 'load' activates the physical sense of the noun, while 'books' leads 'load' to mean the event of bringing an object. The interpretation of the complex expression is not ambiguous. Both expressions, 'load' and 'books', co-operate together to restrict their underspecified meanings. Such a co-operation is directly driven by the syntactic dependency –direct object- relating both expressions. This dependency is viewed here as a device searching within the lexical content of the two expressions the semantic requirements underlying the meaning of the composite. On this basis, it explores the content of 'book' in order to describe 'load' as an event requiring physical objects and not symbolic ones. At the same time, it explores the content of 'load' in order to configure 'book' as an object requiring a bringing event, instead of an internal state change.

This article is organised as follows. First, in section 2, we will define how the basic morphosyntactic categories denote abstract conceptualisations. Then, section 3 will describe how such conceptualisations are involved in the interpretation of composite expressions. Special attention will be paid to the co-composition device driven by syntactic dependencies. Finally, in section 4, we will compare the notion of compositional interpretation defined in the previous section to different assumptions on compositionality in related work.

2. Semantic characterisation of morphosyntactic categories

Semantic approaches to morphosyntactic variation describe categories on the basis of very abstract grammatical conceptualisations. We start this section by introducing briefly how

conceptualisation is viewed in two particular approaches: Property Theory and Cognitive Grammar. Then, two operations of conceptualisation will be proposed to define the two basic morphosyntactic categories: nominals and relationals. Finally, we will analyse how ontological information is organised in the semantic structures built by these operations.

2.1. *Two Approaches to Grammatical Conceptualisation*

Property Theory. This theory aims to account for the semantic interpretation of a particular morphosyntactic mechanism: grammatical nominalisation (Chierchia, 1985; Chierchia and Turner, 1988). In Property Theory, nominalisation is perceived as a particular mode of being of a predicative structure. According to this theory, predicative structures have two "modes of being":

- Firstly, they can appear as incomplete or unsaturated structures, i.e., as predicative functions. The application of a predicative function to the appropriate arguments represents the process of saturating the predicative structure.
- Secondly, predicative structures can also appear as saturated structures. A saturated structure, which is the result of applying a predicative function to the appropriate arguments, is a particular case of individual entity and, as such, it can become the argument of other predicative function. Thus, a nominalised entity is a saturated structure perceived as an argument of a predicate.

Property theory makes the assumption that it is possible to change from a mode of being into the other and conversely, using specific semantic operations, namely "operations of grammaticalisation". For example, nominalisation is a particular case of grammaticalisation that consists in changing predicative functions into nominalised entities. Functionalisation is another type of grammaticalisation that consists in changing nominalised entities into predicative functions.

In a first approach of the theory (Chierchia, 1985), verbal forms are mainly interpreted as predicative functions. From this viewpoint, morphosyntactic clues representing grammatical nominalisers, such as infinitive forms (‘to run’), or the complementiser ‘that’ (‘that + Jean is running’), denote nominalisation operations. These operations change predicative functions, related to finite verbal forms, into nominalised entities. Nominalisations, then, are the semantic objects denoted by the morphosyntactic expressions known as nominalisers.

Nominalisation can be considered as the opposite of functionalisation. In another approach of the theory (Chierchia and Turner, 1988), verbal forms are no longer interpreted as predicative functions but as nominalised entities. From this viewpoint, aspect-temporal morphemes of finite verbs must be considered as semantic entities denoting operations of

functionalisation. For instance, the aspect-temporal morpheme ‘-ed’ would correspond to a functionalisation operation that changes the nominalised entity related to a verbal form (‘look’) into a predicative function related to the finite form (‘look-ed’). Functionalisation is the reverse of nominalisation. These notions are not far from what Carlson called verbal and nominal individuation, respectively (Carlson, 1984).

In Property Theory, operations of grammaticalisation provide accurate formal semantic information to deal with morphosyntactic variation of linguistic expressions. In the semantic space, these operations organise in different ways the predicative structures and the lexical content the linguistic expressions denote. As they are defined as schematic semantic organisers, it is possible to relate them to conceptualisations in Cognitive Grammar.

Cognitive Grammar. Like Property Theory, the main motivation of Langacker's Cognitive Grammar (1987, 1991, 2001) is to build a semantic model of the basic grammatical categories. The theoretical aim of Cognitive Grammar is however more ambitious since it attempts to treat the complex diversity of morphosyntactic conceptualisations. While Property Theory analyses only conceptualisations on verbal expressions (grammatical nominalisation and functionalisation), the analysis of morphosyntactic variations in Cognitive Grammar can be extended to other types of linguistic expressions. In this theory, each morphosyntactic marker is related to a conceptualisation mechanism. Traditional morphosyntactic categories (nouns, verbs, adjectives, adverbs, prepositions...) will thus be related to various semantic conceptualisations.

According to Cognitive Grammar, conceptualisations are mechanisms related to cognitive abilities (e.g., perception, attention, categorisation) that organise and structure the ontological information evoked by linguistic expressions. A particular conceptualisation results in a specific construal imposed on that ontological content. Among the conceptualisation operations, Cognitive Grammar distinguishes "profiling", opposition of "trajector/landmark", or even "processual temporalisation". For example, profiling operation explains the semantic distinction between adjectival and nominal uses of ‘red’, or between the verbal form ‘run’ and the noun ‘(the) running’. The opposition of trajector/landmark makes it possible to account for the changes of perspective within relational predications: ‘to break the glass’ / ‘the glass breaks’, ‘red car’ / ‘the red of the car’, etc. Finally, temporalisation considers the contrasts between expressions like ‘red car’ and ‘the car is red’. In short, Cognitive Grammar uses these abstract operations to distinguish various types of semantic categories. As a result, lexical items can be conceptualised in several ways.

Note that dealing with morphosyntactic alternation in semantic terms comes into conflict

with syntactic-based approaches. Dependency Grammar, for example, uses a syntactic mechanism, called "translation", to deal with morphosyntactic variation (Báez, 1988). Yet, the different modes of translation are viewed here as semantic operations.

2.2. *Two mechanisms of conceptualisation: "participation" and "scenarisation"*

Our aim here is at defining two basic categories: both relationals, which are morphosyntactically codified in verbs, adjectives, adverbs, prepositions, etc., and nominals, which are codified in nouns, nominal phrases, that-sentences, infinitive clauses, etc. Yet, before giving our own definitions of the mechanisms underlying both categories, let us see how Langacker defines both "relational predication" and "nominal predication", which are the grammatical conceptualisations resulting in these categories. According to the author, relational predications put both interconnections and the entities that are interconnected in profile (Figure 1a below). A nominal predication has two different definitions: on the one hand, it designates a set of interconnected entities (Figure 1b); on the other, it designates a region in a domain (Figure 1c).

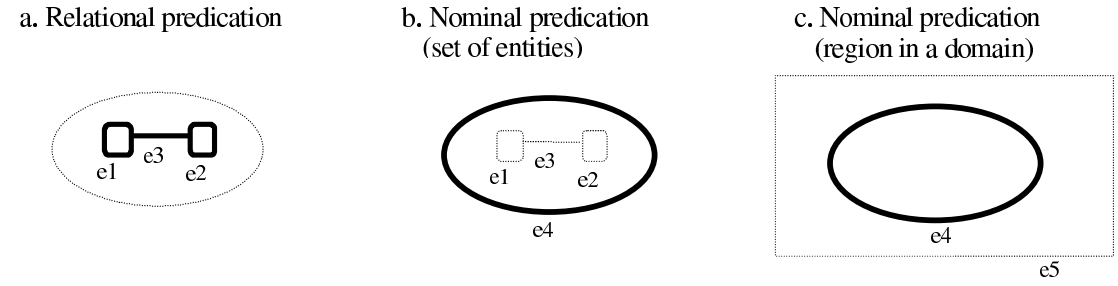

Figure 1: Basic predications (i.e., grammatical conceptualisations) in Cognitive Grammar

Figure 1 depicts these three definitions by using merely 5 ontological entities: *e1* and *e2* are the entities interconnected by means of *e3*. They are put together into the set *e4*, which can be viewed as a region in the domain e5. Some problems arise from the fact of giving two definitions for the same theoretical object, namely the nominal predication. For instance, it is not clear at all if one of the definitions can be derived from the other (e.g., if one of them is a particular case of the other), or if they are two complementary viewpoints of the same phenomenon. Note that if these two predications represent the same object from two points of view, they should represent two different conceptualisations, given that in Cognitive Grammar conceptualisations rely on perceptual operations.

In order to avoid these problems, we re-organise the Langacker's definitions in terms of mereological notions, such as "part-whole" and "whole-part" relationships (Varzi, 1998;

Smith, 1995). Indeed, these relations underlie the basic organisation of the ontological entities that grammatical conceptualisations take as input. It is assumed here that grammatical conceptualisations are cognitive operations, such as mental focusing and figure/background contrast, used to organise the ontological entities at various mereological levels.

As most cognitive approaches, we assume that conceptualisations are abstract mechanisms related to specific abilities of perception. When a viewer perceives an object, he/she can focus, at least, on two different aspects of it: either the internal structure or the external relations it holds with the objects of its environment. In order to schematise and represent these two ways of perceiving the same entity, we must take into account an ontological base organised at three mereological levels (Figure 2a). In this base, we organise the entities used in Figure 1 to define relational and nominal predications. The focus of perception, represented in bold, is the focal entity: it is situated at the focal level between the whole and the constituent levels. The three levels are the following:

- Whole level: at this level, we locate the *whole* or external setting integrating the focal entity. The *whole* corresponds to the domain *e5* illustrated above in Figure 1c.
- Focal level: at this level, we locate the focal entity itself, called *ent*, and its external connections with other potential entities within the whole domain. Horizontal lines represent the potential connections between *ent* and other ontological entities. The focal entity corresponds to *e4*, which appears to be both the region in Figure 1c and the set of interconnected entities in Figure 1b.
- Constituent level: at this level, we locate the interconnected parts of the focal entity. They correspond to *e1, e2* and *e3* in Figure 1a and 1b.

From such an ontological base, we will characterise two ways of perceiving and profiling the focal entity. These two types of profiling will be identified with two types of grammatical conceptualisation: "participation" and "scenarisation".

The participation of the focal entity *ent* consists in focusing on the "part-whole" relation (the upward arrow) between *ent* and the integrating *whole* (Figure 2c). This way, *ent* is conceptualised as a participant of an integrating domain. Note that its interconnected parts are situated beyond the scope of the conceptualisation. Participation is the exclusive conceptualisation of nominal categories: nouns, infinitive clauses, that-sentences, etc.

The scenarisation of the focal entity *ent* consists in focusing on the "whole-part" relations (downward arrows) between *ent* and its internal *parts* (Figure 2b). This allows *ent* to be conceptualised as the scene that integrates its internal constituents and their interconnections. The whole domain of *ent* is situated beyond the scope of the conceptualisation. Scenarisation

is the exclusive conceptualisation of relational categories: finite verbs, adjectives, prepositions, etc.

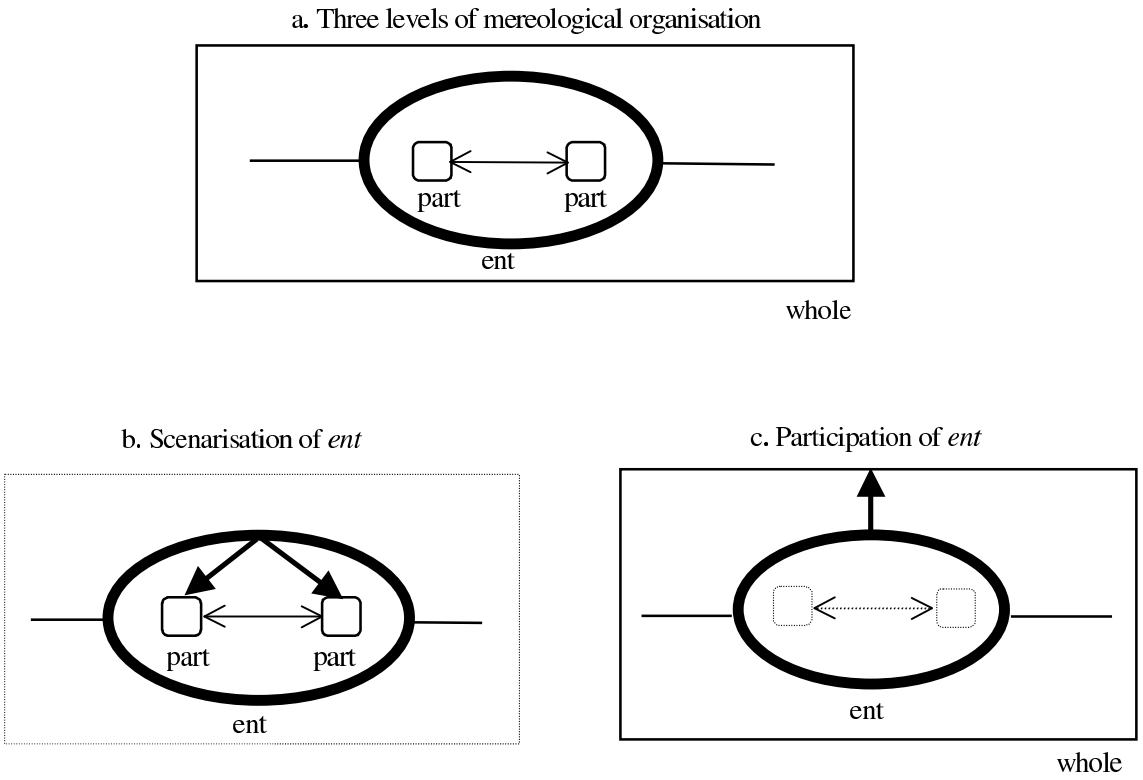

Figure 2: Mereological base and two grammatical conceptualisations

The differences between these conceptualisations and the two Cognitive Grammar's predications are the following:

Firstly, the two conceptualisations defined in our approach can designate the *same* ontological entity in a different way. That is, conceptualisations are conceived as different modes of perceiving the same entity. In Cognitive Grammar, though, nominal and relational predications result in the designation of *different* entities in the same ontological base. Whereas the nominal predication focuses on the global set of interconnected entities (*e4* in Figure 1b), the relational conceptualisation focuses on the interconnected entities and its interconnections (*e1, e2*, and *e3*, in Figure 1a). This way, conceptualisations are not different modes of perceiving the same entity since their focal entities are not the same.

Secondly, we introduce whole-part and part-whole mereological relations both in the ontological base and in the scope of conceptualisation. As we will show later, they play a fundamental role in the compositional device. In Cognitive Grammar, though, mereological relations are not explicitly considered.

Note that participation and scenarisation are not only related to nominal and relational predications in Cognitive Grammar, but also to nominalisation and functionalisation in Property Theory.

2.2. *Two semantic categories: participants and scenes*

The two mechanisms of conceptualisation defined above result in two basic semantic categories: participant and scenes. These categories are semantic structures containing only information about how they may combine with other structures. They represent schematic entities characterised by their combinatorial potentialities. Figure 3 below illustrates two semantic structures: scene $s^{\downarrow}$ and participant $p^{\uparrow}$.

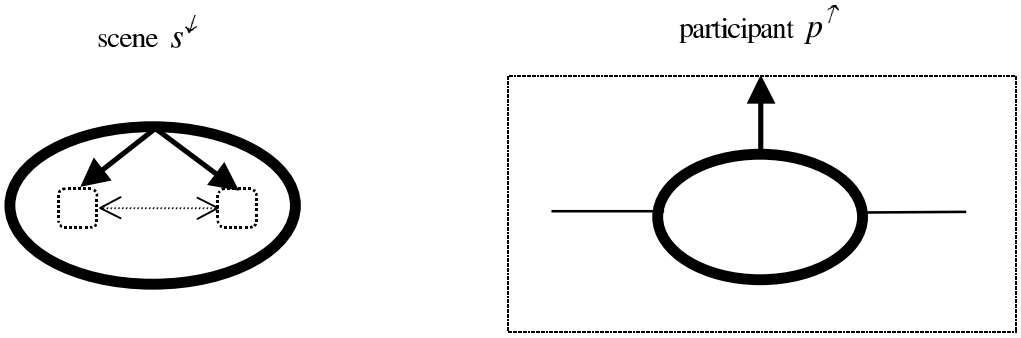

Figure 3: Scenes and participants

Scene $s^{\downarrow}$ conveys the information about the whole-part relations between the focal entity and two undetermined constituents: the interconnected role participants (represented as dotlined small squares). The focal entity is viewed here as a specific whole containing a number of undetermined constituents. These constituents represent the schematic substructures that will be elaborated by specific participants in the compositional process.

Participant $p^{\uparrow}$ conveys the information about the part-whole relation between the focal entity and one undetermined whole. The focal entity is viewed as a specific constituent integrated into the whole. In the compositional process, a specific scene will elaborate the undetermined whole.

Consider the expression 'reading' and the event it evokes. From the ontological viewpoint, the event of reading can be described at three mereological levels of organisation (Figure 4a). At the focal level, the focal entity (in bold) represents itself the event *reading*. At this level, *reading* is likely to hold various relations with other entities, such as spatial and temporal landmarks, different sorts of perceivers, humans giving opinions about the quality of the

event, etc. At the whole level, *reading* is an entity conceived as a part of some integrating action, such as the action localising it in the space and time, the action of perceiving it, the act of giving a critical or an aesthetic opinion about it, etc. Finally, at the constituent level, the *reader* and the symbolic object that is read *(read)* are connected to build together the internal valence of *reading*. They represent, in fact, the particular thematic roles of *reading*. Like all thematic roles, they contain the ontological conditions that enable specific entities to be assigned to them.

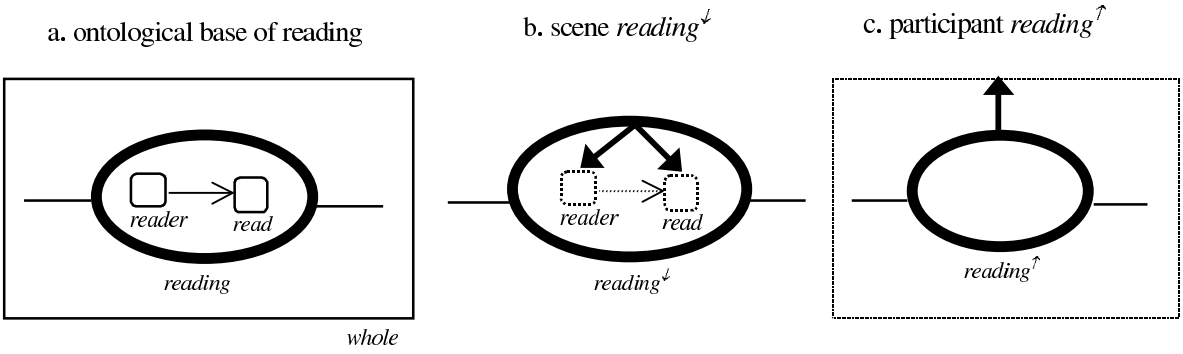

Figure 4: Ontological base of event reading and its grammatical organisations: scene and participant conceptualisations.

The entity *reading* describes a type of event which is characterised by the ontological properties of both the valence structure (its internal constituents or thematic roles) and the potential domains integrating it (its external wholes). Scenarisation and participation takes this ontological base as input in order to give rise to different grammatical organisations.

Scenarisation consists in focusing on the "whole-part" connections between the focal entity and its internal constituents. As far as the event of *reading* is concerned, scenarisation focus on the relations between this event and the two undetermined thematic roles: the individual who is reading (*reader*) and the symbolic object that is read (*read*). The integrating whole of *reading* remains beyond the scope of the designation. The result of this process is the scene, *reading*$^{\downarrow}$, illustrated in Figure 4b. Linguistic expressions such as 'was reading' or 'have read' designate this scene. Downward arrows symbolise the semantic conditions the constituents are required to fill in order to be integrated in the scene. Participants like 'Mary' and 'the book' may elaborate the undetermined constituents, since they fill the semantic requirements. Scenes are semantic structures denoted, not only by verbs, but also by the rest of relational categories: adjectives, prepositions, adverbs, etc. For instance, the adjective 'blue' also denotes a scene with two interconnected internal constituents: an undetermined material object and a specific kind of colour. On this basis, we argue that scenes organise the ontological content evoked by relational expressions as standard subcategorisation frames.

Participation consists in focusing on the "part-whole" connections between the focal entity and the potential wholes integrating it. As far as the event of *reading* is concerned, participation focuses on the relations between this event and the undetermined actions, conceptual domains or more complex events within which it may be an argument. For instance, the events of localising the reading in the space and time, the acts of perceiving it, imagining it, giving a critical or an aesthetic opinion about it, etc. As a part of an integrating whole, the event of reading may be in contact with other entities: a spatio-temporal landmark, a perceiver, etc. The result of such a conceptualisation is the participant *reading*$^{\uparrow}$, which is represented in Figure 4c. The upward arrow illustrates the semantic conditions the wholes must fit in order to the participant be integrated into them. For instance, the scenes denoted by expressions like 'Ann attentively listened to' and 'emotive' fill the semantic restrictions imposed by the participant. This results in the specific semantic structures associated with 'Ann attentively listened to the reading' and 'emotive reading'. Hence, we argue that participants also organise the ontological content evoked by nominal expressions by means of subcategorisation restrictions.

It follows that not only the scenes impose semantic conditions on their participants, but also participants impose semantic restrictions on the scenes into which they may be integrated. This way, the weird interpretation of the expression '?? blue reading' may be explained in two different ways: either, participant *reading*$^{\uparrow}$ does not fit the semantic requirements imposed by scene *blue*$^{\downarrow}$, or scene *blue*$^{\downarrow}$ is not semantically appropriate to elaborate the conditions imposed by participant *reading*$^{\uparrow}$. In the next section, we will describe how syntactic dependencies take as input the two types of subcategorisation restrictions, merge them and yield elaborate meaning interpretations. Co-composition and word disambiguation will be explained on the basis of both modes of imposing semantic preferences.

The characterisation of our semantic categories, *scene* and *participant*, can be considered as a new way of reformulating the Cognitive Grammar's definitions of *relation* and *thing*. This new reformulation is focused on the combinatorial properties of the categories, i.e., on how they organise the subcategorisation information involved in the process of compositional interpretation.

3. Compositional mechanism: integrating a participant into a scene

The compositional mechanism we describe here is the process that takes as input two semantic structures, a participant and a scene, to produce a blended structure sharing some aspects of the input structures. We consider that this compositional mechanism is activated by relations of dependency, such as nominal modifier, verbal modifier, subject, direct object, etc. We will introduce in this section a semantic description of these syntactic relations. Then, we will describe how they activate the compositional process of interpreting composite expressions. Other kinds of syntactic relationships — e.g., coordination, determination, etc. — will not be considered here. Finally, we will analyse the interpretation of "she loaded the books" using the theoretical objects described above.

3.1. *The Semantic Content of Syntactic Dependencies*

Linguistic composition can be conceived as a blending operation that combines a participant construction with a scenic structure. It results in a more specific semantic structure where the participant plays a particular role within the scene. We assume that this kind of compositional process is driven by syntactic dependencies. In the semantic space, syntactic dependencies denote the operational objects that drive the interpretation of composite expressions.

In Figure 5 below, a syntactic dependency is described as a structure containing two parametric substructures - a parametric scene and a parametric participant - as well as two mereological relationships: the whole-part and part-whole relations linking both substructures. The parametric scene $x^{\downarrow}$ is viewed as the whole, while the parametric participant $y^{\uparrow}$ is viewed as its part. The downward arrow symbolises the whole-part relation between the scene and one of its potential participants. More precisely, it represents the semantic restrictions the scene imposes on the participant. The upward arrow symbolises the part-whole relation between the participant and its external whole. In particular, it represents the requirements the participant imposes on the scene. The parametric substructures, scene $x^{\downarrow}$ and participant $y^{\uparrow}$, play the role of "sites of elaboration" in the compositional process. We identify, thus, the notion of parameter to the notion of site of elaboration. The two parameters will be elaborated in the compositional process by a specific scene and a specific participant respectively. Like Langacker, we represent the parametric substructures (i.e., the sites of elaboration) by means of grey backgrounds.

Besides the "participant-scene" structure, dependencies also have a "head-modifier" configuration. A head-modifier configuration is an asymmetric relationship in such a way that

only the morphosyntactic properties of the head are inherited by the composite expression. In Langacker's terms, this corresponds to the imposition of the head profile (or head conceptualisation) to the composite structure. The head is described in semantic terms as the structure used to organise the compound. As heads can be participants or scenes, we claim that syntactic dependencies may impose either the scenic or the participant conceptualisation to the compound. The particular dependency depicted in Figure 5 imposes the profile of participant $y^{\uparrow}$ (in bold) to the composite structure. In other words, the compound inherits the conceptualisation of the participant. Nominal modifiers are syntactic dependencies imposing the participant profile. By contrast, verbal subjects and direct objects impose the profile of the scene.

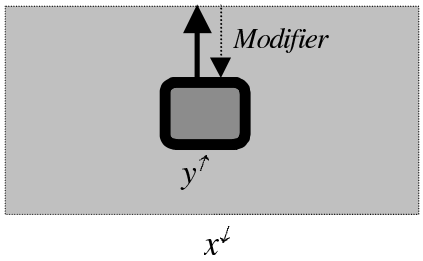

Figure 5: Semantic representation of a syntactic dependency

Unlike Cognitive Grammar, syntactic dependencies are no longer parts of the argument structure of relationals such as verbs, prepositions or adjectives. In Cognitive Grammar, the subject (or "trajector") of the event denoted by a verb corresponds to an internal slot of the event, that is, to an argument role. In our approach, however, the verbal subject is not an internal argument, but an *external operation* allowing the event to be combined with some of its potential participants. Hence, we explicitly separate the syntactic constructions from the internal valency of events. Later, we will explain why the compositional operations must be clearly separated from the lexical content of relationals.

In summary, we define syntactic dependencies as dynamic entities activating and driving the composition process. They are not merely passive cues related in a particular way (linking rules, syntactic-semantic mappings, syntactic assignments, etc.) to thematic roles or lexical entailments of verbs (Dowty, 1989, 1991). They are conceived of as compositional operations taking part in the process of meaning construction. More precisely, they are 2-place operations that apply on the semantic structures of the dependent expressions. In the following paragraph, we will describe how such operations are applied on the semantic

structures to construct more specific structures representing the meaning of composite expressions.

3.2. *Co-compositionality*

The interpretation of composite expressions is reached by the compositional properties of syntactic dependencies. Compositional interpretation consists in integrating a participant into a scene by assigning the participant to a specific role of the scene. Such a process is constituted by two internal operations of elaboration (arrows A and B in the Figure 6 below):

A. the specific scene $s^{\downarrow}$ elaborates the parametric scene $x^{\downarrow}$

B. the specific participant $p^{\uparrow}$ elaborates the parametric participant $y^{\uparrow}$

This double elaboration represents, in fact, what we have called dynamic co-composition. That is, in the compositional interpretation, scene $s^{\downarrow}$ elaborates some semantic aspects of participant $p^{\uparrow}$, and conversely, $p^{\uparrow}$ elaborates some semantic aspects of $s^{\downarrow}$. The role of the schematic syntactic dependency in this compositional process is similar to the Fauconnier and Turner's *generic space*. For these authors, the generic space allows two input spaces to be blended in a composite space (Fauconnier and Turner, 1998; Turner and Fauconnier, 1995).

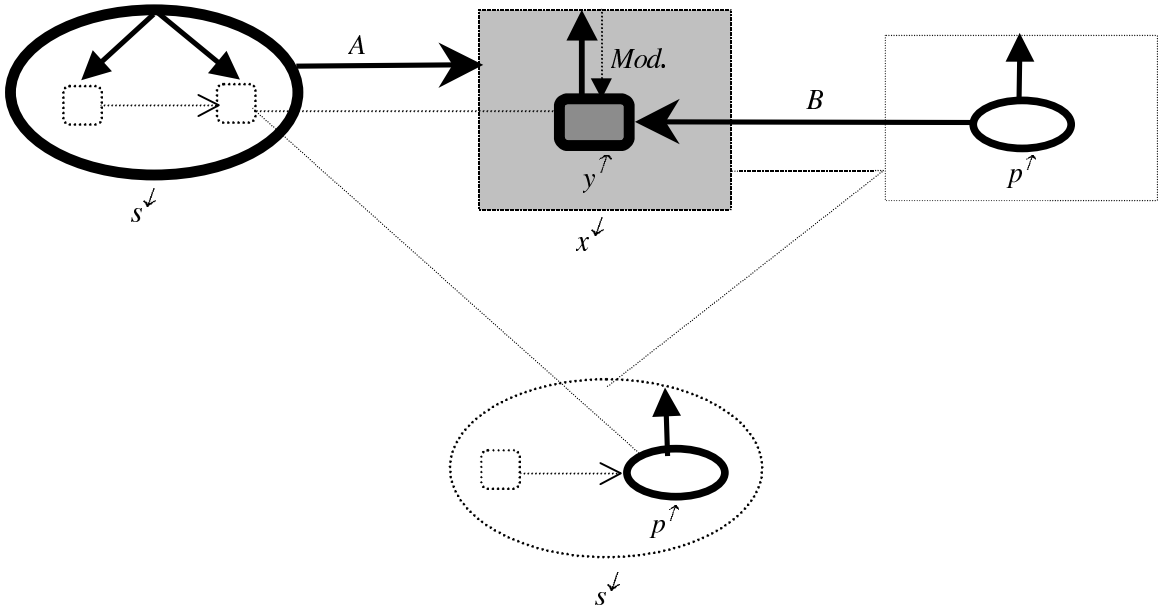

Figure 6: Compositional mechanism

As in Cognitive Grammar's constructions and Fauconnier's mental spaces, elaborations are coming with some ontological correspondences and identifications among some of the entities taking part in the compositional process. Correspondences and identifications are the result of blending into a composite structure some components shared by the input structures, i.e.,

components that the participant and the scene have in common. Correspondences and identifications are represented in Figure 6 by means of dotted lines:

On the one hand, elaboration A leads the parametric participant $y^{\uparrow}$ to be identified to one of the underspecified parts of the scene (i.e., one of its internal roles). Thereby, the subcategorisation restrictions underlying this internal role are transferred to the parametric participant. They are the restrictions that the specific participant $p^{\uparrow}$ must fit in order to be integrated into the scene. In case it fits such restrictions, elaboration A is reached, and then, the internal role of the event is identified with the specific participant in the composite structure.

On the other hand, elaboration B leads the parametric scene $x^{\downarrow}$ to be identified to the underspecified whole in the participant structure. This allows the subcategorisation restrictions underlying this whole to be transferred to the parametric scene. Indeed, they are the selection restrictions that the particular scene $s^{\downarrow}$ must fit in order to let the participant integration. If the scene is appropriate for these restrictions, elaboration B will be reached. As a result, the underspecified whole appears to be identified with the specific scene involved in the composite structure.

The syntactic dependency can be defined in semantic terms as the process of transferring subcategorisation restrictions from the two input structures to its two own parameters. During the process of compositional interpretation, the dependency builds a 2-place subcategorisation frame: One place is occupied by $x^{\downarrow}$, which is used to project the semantic restrictions the specific scene $s^{\downarrow}$ imposes on its potential participants; the other place is occupied by $y^{\uparrow}$, which is used to project the semantic requirements the participant $p^{\uparrow}$ imposes on the potential scenes into which it can be integrated.

The result of the compositional mechanism is a blended structure which inherits, in this particular case, the profile of the participant. The composite structure, then, is conceptualised as a participant, $p^{\uparrow}$, carrying specific information about a particular scene: $s^{\downarrow}$. The integration of the participant into the scene has been achieved by means of two semantic elaborations: the participant elaborates the semantic requirements of the scene (arrow A), and the scene elaborates the semantic restrictions imposed by the participant (arrow B). In the example we will analyse in the following subsection, this double elaboration will be used to disambiguate word meaning. Word disambiguation will be achieved when the specific role the participant plays in the scene is finally revealed in the composite structure.

3.3. *Analysis of an Example*

The semantic interpretation of a composite expression involves the following information:

- the dynamic nature of the syntactic dependency, which possesses the compositional properties allowing two expressions to be combined,
- the grammatical conceptualisations of the two combined expressions, as well as the ontological information associated with their lexical units.

The output of the interpretation process is a semantic structure built by selecting some aspects of the morphosyntactic and lexical information contained in the input structures. In most cases, the polysemic lexical information of the input structures is disambiguated in the process of building the blended structure.

Let us take an example. Consider the syntactic dependency between 'she loaded' and 'the books' in the composite expression 'she loaded the books'. The linguistic elements taking part in the compositional interpretation are the following:

1. the lexical information conveyed by 'load' (which is the lexical head of 'she loaded'), as well as the lexical information conveyed by 'book' (which is the lexical head of 'the books'),
2. the morphosyntactic information (i.e., verbal and nominal information) conveyed by these two expressions,
3. the combinatorial properties associated with the *direct object* syntactic dependency, by means of which 'she loaded' and 'the books' are related.

Underspecified lexical information. As has been said in section 1.2, the lexical items 'load' and 'book' convey various sorts of lexical indeterminacy. On the one hand, the verbal item 'load' may refer to either the event of bringing objects into a place ('Ann loaded the hay into the truck'), or the event of changing the state of a place ('Ann loaded the truck with the hay'). On the other hand, 'book' may denote either a physical object ('put the book on the table'), or an informative content ('naive book'). Yet, the principles organising lexical meaning have not been considered in this article.

Morphosyntactic information and conceptualisation. In addition to lexical information, the two combined expressions also possess morphosyntactic properties. Whereas the verbal expression 'she loaded' is morphosyntactically categorised as a relational, 'the books' is categorised as a nominal. This way, the former denotes a scene and the later a participant.

Figure 7a illustrates a scenic organisation of the event of loading. The scene *she_load*$^{\downarrow}$ is oriented towards its internal participants, which represent the specific thematic roles of the verb 'load':

- *loader*, which is taken as an underspecified source of movement (it is a particular case of *agent*). In fact, the previous combination between 'she' and 'loaded, driven by the *subject* relation, led the *loader* role to be elaborated by the specific participant denoted by 'she': *loader:she*$^{\uparrow}$.
- *load*, which is taken as an underspecified moving object likely to be brought and located into a place (it is a particular case of *theme*),
- *loaded*, which is taken as the underspecified place where the load is located (it is a particular case of *goal*).

The horizontal arrows illustrate the various ontological links interconnecting the participant roles of the scene. The activation of some of those links represents, in fact, a particular configuration of the scene. The arrows connecting the *loader* to the *load*, and this one to the *loaded* active the configuration of bringing something (the *load*) into a place (the *loaded*), while the arrow directly linking the *loader* to the *loaded* actives the configuration of changing the state of a place (the *loaded*). Both scenic configurations represent the two potential meanings of the lexical item 'load'.

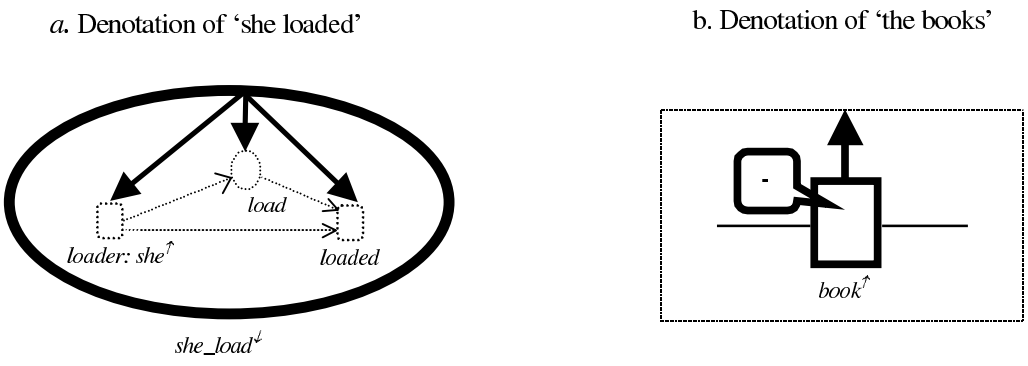

Figure 8: scene *she_load*$^{\downarrow}$ and participant *book*$^{\uparrow}$

Figure 7b illustrates the participant organisation denoted by the nominal 'the books'. As has been said above, we do not take into account the information associated with the determiner nor the plural marker. Such an organisation, noted *book*$^{\uparrow}$, represents a complex focal entity constituted by a physical support and the informative content it contains. This entity is integrated into an underspecified whole. In the compositional process, either physical

or symbolic-informative scenes can elaborate the whole. Physical scenes (such as the scene of putting the book on the table) will activate and select the physical aspect of the polysemic noun 'book'. On the other hand, informative scenes (like the scene of reading the book) will select the symbolic facet.

Syntactic dependency and compositional mechanism. The two conceptualised entities we have defined above, *she_load*$^{\downarrow}$ and *book*$^{\uparrow}$, are the input structures of the compositional mechanism. This mechanism is driven by the *dobj* (direct object) dependency. Figure 8 below shows how *dobj* allows the two conceptualised structures to be combined to build a higher-order blended structure, called *she_bring_phy*$^{\downarrow}$. This blended semantic structure inherits some morphosyntactic and lexical information from the input structures. The dependency *dobj* is an operational object constituted by two parametric entities: parametric scene $x^{\downarrow}$ and parametric participant $y^{\uparrow}$. Since the two parameters are conceived as sites of elaboration, they will be elaborated in the compositional process by a specific scene and a specific participant, respectively. Furthermore, *dobj* also possesses the following compositional property: it imposes the category of the scene (in bold) to the blended semantic structure. So, the output of the compositional mechanism inherits the scenic conceptualisation from the input scene.

As has been said, composition is considered here as the process of integrating a participant into a scene. The integration illustrated in Figure 8 consists in assigning the participant *book*$^{\uparrow}$ to a particular thematic role of the scene *she_load*$^{\downarrow}$. In order to reach such a semantic integration, the syntactic dependency triggers and drives two operations of elaboration:

A. specific scene *she_load*$^{\downarrow}$, which is denoted by 'she loaded', elaborates the parametric scene $x^{\downarrow}$;

B. specific participant *book*$^{\uparrow}$, which is denoted by 'the books', elaborates the parametric participant $y^{\uparrow}$.

This double elaboration presupposes the construction of a 2-place subcategorisation frame containing the appropriate selection restrictions. On the one hand, parameter $x^{\downarrow}$ contains the restrictions that *book*$^{\uparrow}$ must fit to be assigned to one of the roles of scene *she_load*$^{\downarrow}$. These restrictions are defined by exploring the lexical content of both *book*$^{\uparrow}$ and *she_load*$^{\downarrow}$. Since *book*$^{\uparrow}$ cannot be considered as a spatial place likely to be loaded, it does not fit the requirements to be assigned to role *loaded*. In fact, *book*$^{\uparrow}$ seems to fit only the conditions of role *load* in the direct object position. Given that restrictions on *load* assignment are transferred on parameter $x^{\downarrow}$, the verb is coerced by the meaning of 'book' to refer to the

specific event *bringing something into a place*. On the other hand, parameter $y^{\uparrow}$ contains the restrictions that *she_load*$^{\downarrow}$ must fit in order to accept the integration of participant *book*$^{\uparrow}$. Given that this scene does not refer to a symbolic event, participant *book*$^{\uparrow}$ only is located into physical domains. So, parameter $y^{\uparrow}$ requires the participant to be integrated into a physical scene. On this basis, the participant is perceived as a physical object and not as a symbolic entity. In the same way than *book*$^{\uparrow}$ specifies the sense of 'load', the physical information evoked by the scene *she_load*$^{\downarrow}$ disambiguates the polysemic content of 'book'.

In sum, the *direct object* dependency builds dynamically the 2-place subcategorisation frame by exploring the lexical information of the two dependent expressions. We called such a dynamic construction "co-composition". Double elaboration is achieved when the two parametric places are filled by the two semantic structures associated with the dependent expressions.

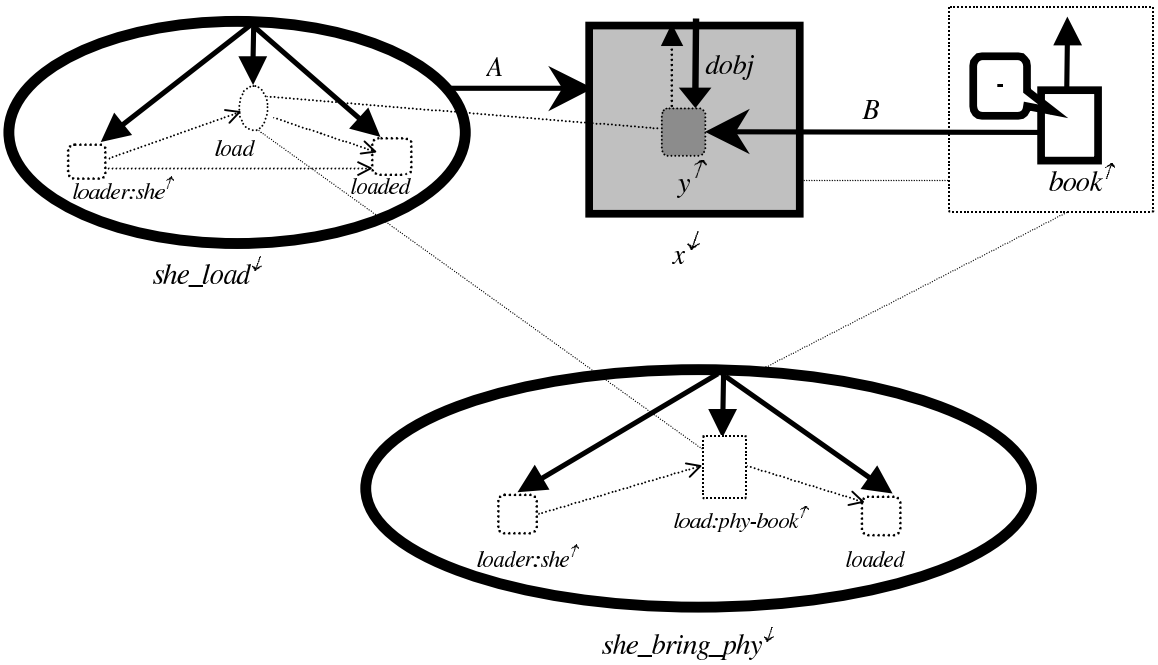

Figure 8: Co-compositional interpretation of the dependency relating *she_load*$^{\downarrow}$ *and book*$^{\uparrow}$

The result of the compositional mechanism is a blended structure which inherits the conceptualisation from the input scene. Such a composite structure represents the scene *she_bring_phy*$^{\downarrow}$. The scenic imposition is due to the specific compositional properties of the *dobj* dependency. Indeed, the head of *dobj* is the verbal expression. Other syntactic

dependencies such as *nominal modifiers* impose not the scenic but the participant conceptualisation.

In the composite expression 'she loaded the books', words 'load' and 'book' are no longer polysemous expressions. Blending is viewed here as the process of activating and selecting particular substructures from the two input structures. To be more precise, the syntactic dependency activates the bringing sense of 'load' as well as the physical sense of 'book'. The information that is not involved in co-composition remains beyond the focal scope of the blended structure.

In addition, the blended output represents a scenic structure that may be combined with other semantic structures (e.g., the participant denoted by 'the lorry'), by means of further syntactic dependencies (e.g., *prepositional complements).* Indeed, the dependency introduced by the preposition 'into' may lead 'she loaded the books' to be combined with 'the lorry' so as to build a still more complex verbal expression: 'she loaded the books into the lorry'. In terms of semantic interpretation, the meaning of this composite structure is built by merging the specific scene *she_bring_phy*$^{\downarrow}$ with the participant *lorry*$^{\uparrow}$. Semantic interpretation of composite expressions is an incremental process: expressions are interpreted as they are incrementally attached by dependency relations.

4. Related approaches to compositional interpretation

Our proposal on compositionality is based on two main assumptions. First, we assume that the compositional mechanism is not directly projected from the lexical information associated to one of the constituent expressions. It is not the verb or the adjective that projects its subcategorisation information on the compositional device. Rather, we postulate the existence of an external compositional object, which is clearly separated from the combined expressions. Such an object, associated to the syntactic dependency, goes in search of compositional constraints all through the lexical information of the combined expressions, in order to build the meaning of the composite expression. This dynamic object leads to a co-compositional interpretation. Co-compositionality is only possible if it is postulated the existence of an external device selecting partial aspects of the meaning of the combined expressions. The second assumption concerns the type of linguistic information involved in semantic interpretation. We argue that both morphosyntactic and lexical information are two kinds of semantic information that are accessible at the same time in compositional interpretation. Whereas morphosyntactic cues introduce different conceptualisations, lexical

information evokes ontological knowledge. Both conceptualisations and ontological knowledge are fundamental aspects of the interpretation process.

These two assumptions may be compared to the compositional notions underlying other theoretical frameworks and semantic approaches. Some differences and similarities will be outlined in the following paragraphs.

4.1 *Projecting lexical subcategorisation in composition*

The first assumption is absent of the notion of composition in many linguistic approaches. We will analyse here Cognitive Grammar and model-theoretic frameworks based on Categorial Grammar.

Composition and Cognitive Grammar: Consider Figure 9 below. The compositional process illustrated in this figure represents the combination of the nominal predication *"the books"*, with the relational predication *"She loaded"*. The relational predication represents here a particular event configuration (or argument structure) of the verb "to load". It configures the *sense "bringing something to a place"*. In this predication, the substructure *tr* (trajector) is filled by the nominal *"she"*, identified as the subject and containing the ontological information concerning the role *loader*. Substructure *ld1* (first landmark) represents the direct object, which contains here the specific information concerning the thematic role *load*. Finally, *ld2* (second landmark) represents the prepositional complement, which contains here the information concerning the role *loaded*. The nominal *"the books"* elaborates a substructure of the relation, in particular the first landmark (*ld1*), which appears as a small circle in grey. As it is the only substructure that is elaborated, it represents the site of elaboration of the compositional mechanism. Note that the relation *"she loaded"* does not elaborate anything of *"the books"*.

Since it is the relational predication that drives the compositional mechanism, we need to previously go in search of the appropriate subcategorisation frame through the lexical meaning of the verb 'to load'. Once the verbal frame is selected, it is used as the base for composition. This procedure presupposes that we need to disambiguate the verb before starting the construction of the compositional meaning. That is, it is necessary to previously select the event configuration *bringing something to a place,* before interpreting the meaning of the composite expression that combines *"she loaded"* with *"the books"*. This is why we say that the compositional mechanism is not here separated from the combined structures. As Figure 9 depicts, the combinatorial operation is integrated in a particular substructure of the

relational predication, namely the parametric argument *ld1*, appearing as the potential site of elaboration.[2]

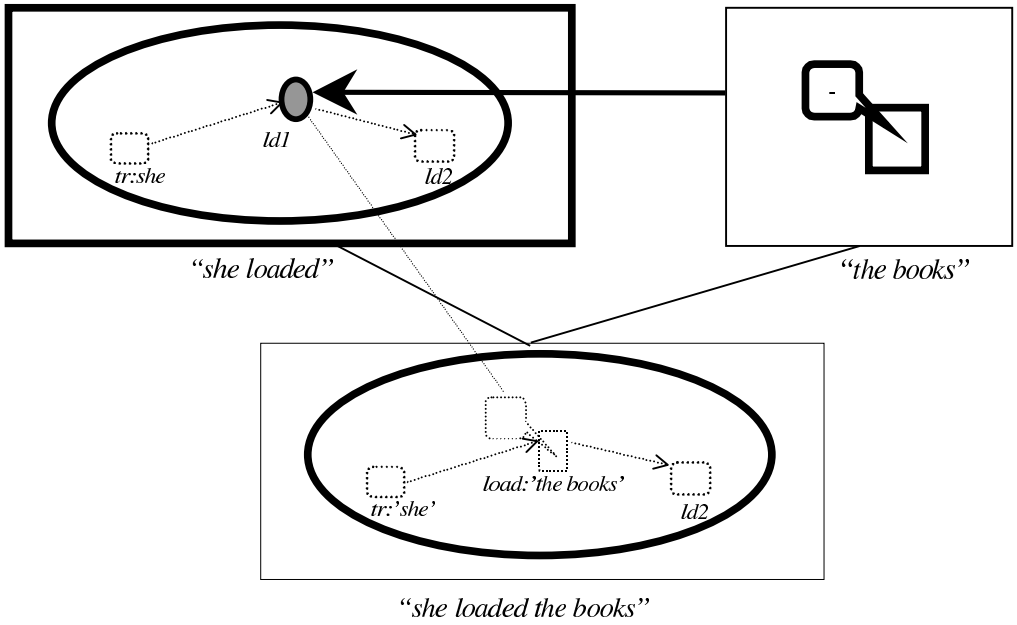

Figure 10: Combining "she loaded" with "the books" in Cognitive Grammar

This leads compositionality to be reduced to a single operation of elaboration. The nominal predication elaborates a substructure of the relation, but the later does not elaborate any aspect of the former. Mutual elaboration is then prevented. As the operation of elaboration takes only one direction, Figure 9 shows a single arrow of elaboration going from the nominal to the first landmark of the relation.

We argue that the fact of not separating the mechanism of composition from the combined structures makes dynamic co-composition and, then, word disambiguation impossible.

Composition and model-theoretic approaches: Model-theoretic approaches situate the verb denotation at the centre of the compositional process. Verb denotations are represented as predicative functions containing the compositional properties of sentences. For instance, the verb 'to load' denotes, when it refers to the sense of *bringing something into a place*, a 3-place predicative function. In particular, it denotes the function that will be applied to three arguments: a specific agent, a specific theme and a specific goal. The application of the function to these three arguments results in either a truth-value, a situation, a mental space, a propositional content, or whatever sentence content required by the theory. Typically, that predicative function is represented as a lambda expression, such as:

$\lambda x, \lambda y, \lambda z(Load , x^{agent} y^{theme} z^{goal})$

A particular verb's meaning is then defined as a predicative function containing the mechanism used to compose the elaborate meaning of the sentence. Yet, as has been said above, significant problems arise when the compositional mechanism is associated with the sense of polysemic verbs:

- First, compositional interpretation is activated only if a particular meaning of the polysemic verb has already been selected by a previous semantic analysis of the sentence. Indeed, the predicative function above merely describes one of the particular senses of verb 'to load', namely *bringing something into a place*. Further possible senses of this verb would be described by other compositional functions. This means that the verb's meaning must be disambiguated before the process of semantic composition. In other words, the specific meaning of the verb must be determined before the process of combining the verb with its arguments. This seems to be problematic in psycholinguistic terms.
- Second, the compositional mechanism is activated only if the particular senses of the verb arguments have already been selected in a previous semantic analysis. Indeed, the predicative function described above can be applied only if there are three nominal expressions previously identified as agent, theme and goal. That means that the task of disambiguating the meaning of the nominal arguments is previous to and independent of the combinatorial process. This is also spurious in psycholinguistic terms.

Those problems show that work on model-theoretic interpretation provide a conception of composition that does not allow to model dynamic co-composition. That is, composition in model-theoretic approaches does not account for the fact that the verb can both disambiguate and be disambiguated by its nominal arguments when they are combined. In such approaches, semantic disambiguation takes precedence over the mechanism of compositional interpretation.

This conception of composition is directly related to linguistic frameworks based on lexicalised grammars (Lexical Functional Grammar, Lexical Tree-Adjoining Grammars, etc.). In those grammars, each lexical meaning (e.g., the meaning "*bringing something into a place*" of the verb 'to load') is projected onto a particular syntactic structure. Syntactic composition, thus, depends on the specific senses of lexical items. The way in which a specific sense is selected is a problem addressed to other linguistic modules, independent of the syntactic level.

In our framework, however, compositional information is not projected from the particular subcategorisation structure underlying the verb's meaning. Rather, subcategorisation restrictions are dynamically built by the syntactic dependency, which explores the lexical content associated with the two related expressions, and selects compatible information. For instance, in order to interpret the composite expression 'load the books', we must consider at the same time the verb, the nominal, and the binary predicative function projected by the *direct object* syntactic relation. The predicative function may be represented as a lambda expression with two arguments:

$$\lambda x, \lambda y\ (\textit{Direct_Object}\ , x^{\downarrow}\ y^{\uparrow})$$

Parameter $x^{\downarrow}$ symbolises the requirements the scene must fit. Conversely, parameter $y^{\uparrow}$ represents the conditions required by the participant to be integrated into the scene. The application of this predicative function to both the denotations of 'load' and 'the books' works as follows: the underspecified scene denoted by the polysemic verb 'load' elaborates the requirements of the scenic parameter, $x^{\downarrow}$, whereas the underspecified participant denoted by the polysemic nominal 'the books' elaborates the participant parameter $y^{\uparrow}$. The scenic structure denoted by the verb and the participant structure denoted by the nominal are then blended and merged thanks to the compositional process driven by the *direct object* dependency. Such a blending process consists in selecting and activating particular facets of the two underspecified structures to build up a more specific composite structure. Thus, the process of disambiguating both the polysemic verb and noun is not reached in a previous step before compositional interpretation, but at the same time than the composite expression is interpreted.

Linking rules and Constructions: The integration of the compositional mechanism into the semantic structure of verbs makes it difficult to account for verbal alternations, i.e., polymorphic verbs that possess various subcategorisation frames (e.g., 'Ann loaded the hay into the truck' *versus* 'Ann loaded the truck with the hay'). Most approaches to verb alternations assume that there should be some sort of external semantic mechanism controlling and modulating the mapping between the lexical subcategorisation of verbs and the surface syntactic forms of sentences. Different sorts of proposals - e.g., lexical rules and semantico-cognitive constructions - have been made to define semantic mechanisms resulting in syntactic alternations of verbs:

✓ *Lexical rules*: The mapping between the verb semantic frame and the surface syntactic form can be modified by means of "lexical rules". These rules operate on verb semantic frames (Pinker, 1989; Levin and Rappaport, 1996; Davis, 1996). For example:

– The semantic frame of the verb 'to load' refers to the event <X causes Y to go to Z>, which is directly linked to the surface syntactic form [Xsubj -Yobj – to Z].

  Such a form accounts for the expressions: 'Ann loaded the hay into the truck', 'Ann loaded the truck into the boat', etc.

– Yet, there is a lexical rule that modifies the semantic frame <X causes Y to go to Z> to obtain the frame <X causes Z to have Y>, which is directly linked to the surface syntactic form [Xsubj -Zobj – with Y].

  Such a form account for the expressions 'Ann loaded the truck with the hay', 'Ann loaded the boat with the trucks', etc.

✓ *Constructions*: The mapping between the semantic frame of the verb and the surface syntactic form depends on the interaction between the verb semantic frame (constituted by "participant roles") and semantico-cognitive constructions (constituted by "argument roles"), which are independent of the verb frame (Goldberg, 1996). For example:

– The semantic frame of the verb 'to load' refers to the participant-role structure <loader, load, loaded>, which interacts with the argument-role structure CAUSE-MOVE: <Xag, Ytheme, Zgoal>, in order to allow the participant-role structure to be linked to the surface syntactic form [Xsubj – Yobj - to Z].

  Such a form accounts for the expressions: 'Ann loaded the hay into the truck', 'Ann loaded the truck into the boat', etc.

– The semantic frame of the verb 'to load' may also interact with the argument-role structure CAUSE-CHANGE-STATE.: <Xag, Ypatient, Zinstr>, in order to allow the participant-role structure to be linked to the surface syntactic form [Xsubj - Zobj – with Y].

  Such a form accounts for the expressions: 'Ann loaded the truck with the hay', 'Ann loaded the boat with the trucks', etc.

Lexical rules and constructions are two different means of transforming the meaning of verbs in order to account for their syntactic alternations. Like our definition of syntactic dependencies, they are mechanisms that are clearly separated from the subcategorisation frames associated with verbs. Hence, our approach may be situated within this tradition.

4.2. ***Morphosyntactic and lexical constraints in semantic interpretation:*** There is a fundamental difference between our framework and research on linking rules and constructions. Lexical rules and constructions are defined as semantic constraints on the syntactic rules of a particular generative grammar. They try to restrict syntactic analysis. More precisely, the lexical and semantic information contained in lexical rules and constructions is used to limit the number of potential analysis. So, they cannot be considered as rules taking part in the interpretation of the sentence meaning. Although they have a direct influence in the interpretation process by limiting the number of syntactic analysis, they are not interpretation rules. Rather, they operate before semantic interpretation. In summary, these approaches belong to the syntax-oriented tradition, in which there is a more or less indirect mapping from thematic roles to surface structure. We follow, on the contrary, the semantic-oriented approaches, which consider syntax as the more abstract facet of semantics (Langacker, 1987-1991; Wierzbicka, 1988). So, our aim is not to use some lexical aspects of verbs to restrict structural ambiguity. Rather, we attempt at modelling semantic interpretation by taking into account all linguistic information at our disposal. From this viewpoint of Grammar (in a very broad sense), syntactic structures are no longer conceived of as the input of semantic interpretation, but rather as conceptual constraints which collaborate with other linguistic constraints, so as to achieve a particular semantic interpretation. More precisely, we use both the conceptualisations associated to morphosyntactic categories and the ontological knowledge evoked by lexical items, to model the interpretation of composite expressions.

On this basis, syntactic dependencies are situated at the centre of the process of semantic interpretation. They do not represent any more passive entities constituting complex syntactic forms. We conceive them as conceptual and dynamic operations involved in meaning understanding. In particular, a syntactic dependency takes as argument morphosyntactic and lexical information and produces a semantic structure containing a specific role assignment. Note that the ontological description of the specific thematic role (agent, theme, patient, ...) is not a priority here. We do not propose a theory on thematic roles. Our model is about the process of obtaining a specific semantic value (thematic role, event configuration, or whatever), by exploring the linguistic information associated with syntactically dependent structures.

These ideas are no far from some psycholinguistic approaches to language understanding (McRae et al., 1997; Tyler, 1989; Tanenhaus, 1989). They describe syntactic processing and sentence understanding as a mechanism giving access simultaneously to morphosyntactic and lexical information. According to this assumption, both information sources must be

processed in parallel. They argue that the listener reaches a particular interpretation by grasping at the same time morphosyntactic and lexical information. In opposition to the more standard approaches in which words are interpreted only once the syntactic structure is built, here both syntactic analysis and semantic interpretation merge into one and the same process. In other words, building the syntactic structure of a sentence and interpretating it are not two different processes any more: both tasks represent the same semantic procedure.

5. Conclusion

As recent work on cognitive linguistics, we assumed in this paper that morphosyntactic categories and syntactic dependencies are related to structures and operations endowed with semantic meaning. We also considered that these meaningful structures and operations represent the basic scaffolding of semantic composition. Morphosyntactic categories were viewed as abstract conceptualisations containing information about their modes of combination. We have distinguished two main modes of combination: the act of being combined as a participant, and the act of being combined as a scene. Syntactic dependencies have been defined as the basic operations driving semantic composition. In particular, we conceived them as binary operations projecting morphosyntactic and lexical restrictions to the two dependent expressions. In case of dependencies representing verbal functions (e.g, subject, direct object, ...), the compositional operation gives as result specific thematic role assignments. As the notion of thematic role is not analysed in our work, we do not make the assumption that it could be the only means to represent event structure. This is not relevant for our proposal. We are merely interested in how the linguistic information associated with the related expressions is used to obtain a particular semantic value (for instance, a particular thematic role). Our aim is to analyse the interpretation process itself and not the representation of the semantic structures resulting from this process. Although polysemic information related to lexical items has not been suitably represented, we described how it may be disambiguated in a dynamic way. We termed this process "dynamic co-composition". Finally, we opposed this conception of compositionality to the central aims of current research in linguistics. It is broadly assumed that some lexical aspects of verbs (e.g. argument structure, verbal valency, etc.) become the central structures in composition. In our approach, however, argument structure and internal valency are merely viewed as linguistic constraints,

which collaborate with other information sources (e.g., ontological knowledge evoked by other lexical items) in order to composite expressions be interpreted.

Notes

[1] That is the aim of other current work (Gamallo, 2000a; Gamallo, 2000b).
[2] Note that the operation of imposing a profile (or conceptualisation) to the composite is also an internal property of the relational predication. In Figure 9, it is the relation "she loaded" that imposes its profile on the compound. This is why the square surrounding the predication is in bold.

References

Báez San José, V. 1988. Fundamentos Críticos de la Gramática de Dependencias. Madrid: Editorial Síntesis.

Borgo, S., Guarino, N. and Masolo C: 1996. "Stratified ontologies: the case of physical objects". Workshop on Ontological Engineering, ECAI-96.

Carlson, Greg N. 1984. "Thematic roles and their role in semantic interpretation", Linguistics 22: 259-279.

Chambreuil, M., Ben Gharbia, A., Bernigot, C., Gamallo, P. ,Panissod, C. and Reinberger M.C. 1998. Sémantiques. Paris: Hermès.

Chierchia, G. 1985. "Formal Semantics and the Grammar of Predication" Linguistic Inquiry 16(3): 417-443.

Chierchia, G. and Turner R. 1988. "Semantics and Property Theory". Linguistics and Philosophy 11(3): 261-302.

Davis, T. 1996. Lexical semantics and linking in the hierarchical lexicon. Ph D. in Stanford University.

Dowty, D.R. 1989. "On the semantic content of the notion of Thematic Role". In Properties, Types and Meaning, Vol 2. Kluwer Academic Publishers, 69-130.

Dowty, D.R. 1991. "Thematic proto-roles and argument selection". Language 67(3).

Fauconnier, G. and Turner, M. 1998. "Conceptual Integration Networks" Cognitive Science 22(2): 133-187.

Gamallo, P. 2000a. "La métonymie dans le processus d'interprétation d'expressions complexes". Sémantique et Pragmatique 8: 29-58.

Gamallo, P. 2000b. "Bases léxicas organizadas mediante un sistema de herencia mereológica". Procesamiento del Lenguaje Natural 24: 65-72.

Gamallo, P. , Agustini, A. and Lopes, G, 2002. "Using Co-composition for Learning Syntactic and Semantic Subcategorisation". Workshop SIGLEX-ACL'02 (Conference of the Association of Computational Linguistics).

Goldberg, A. 1995. Constructions: A Construction Grammar Approach to Argument Structure. University of Chicago Press.

Hudson, R. 1990. English Word Grammar. Basil Blackell.

Langacker, R.W. 1987. Foundations of Cognitive Grammar, Vol. 1, Theoretical Prerequisites. Standford: Standford University Press.

Langacker, R.W. 1991. Foundations of Cognitive Grammar, Vol. 2, Descriptive Applications. Standford: Standford University Press.

Langacker R.W. 2001. "Viewing and experiential reporting in Cognitive Grammar". In: Augusto Soares da Silva (ed.), Linguagem e Cognição, Associação Portuguesa de Lingüística. Braga, Portugal, 19-50.

Levin B. and Rappaport, M. 1996. "Lexical semantics and syntactic structure". In Shalom Lappin (ed.), Contemporary Semantic Theory. Blackwell Publishers, 487-508.

McRae, K., Ferreti, T:R., and Amoyte, L. 1997. "Thematic Roles as Verb-specific Concepts". In M. C. MacDonald (ed.), Lexical Representations and Sentence Processing, 137-176.

Mineur, A. and Buitelaar, P. 1996. "A compositional treatment of polysemous arguments in Categorial Grammar". In K. Van Deemter and S. Peters (eds.), Semantic Ambiguity and Underspecification. CSLI, Chigaco University Press.

Pinker, S. 1989. Learnability and Cognition: the acquisition of argument structure. MIT Press.

Pustejovsky, J. 1995. The Generative Lexicon. Cambridge: MIT Press.

Ramsay, A. 1994. "The Co-opertative Lexicon". In Harry Bunt, Reinhard Muskens, Gerrit Rentier (eds.), Proceedings of International Workshop on Computational Semantics.

Smith, B. 1995. "Formal Ontology, Common Sense and Cognitive Science". Journal of Human Studies 43: 641-664.

Tanenhaus, M.K. and Carlson, G.N. 1989. "Lexical structure and language comprehension". In William Marsllen-Wilson (ed.), Lexical representation and Process. Massachusetts, 530-561.

Turner, M. and Fauconnier, G. 1995. "Conceptual Integration and Formal Expression". Journal of Metaphor and Symbolic Activity 10(3).

Tyler, L.K. 1989. "The role of lexical representations in language comprehension". In William Marsllen-Wilson (ed.), Lexical representation and Process, Massachusetts, 439-462.

Varzi, A.C. 1996. "Parts, wholes and part-whole relations: the prospects of mereotopology". Data and Knowlodge Engineering 20: 259-286.

Victorri, B. and Fuchs, C. 1996. "La polysémie : construction dynamique du sens". Paris: Hermès.

Wierzbicka, A. 1988. The Semantics of Grammar. Amsterdam: Benjamins.