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On the status of the deep-syntactic structure

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Résumé – Abstract

Cet article défend un point de vue apparemment paradoxal : la structure syntaxique profonde est une représentation fondamentale de la phrase, mais elle ne doit pas être considérée comme une structure intermédiaire dans la correspondance sens-texte. Nous pensons que la correspondance du niveau sémantique au niveau syntaxique de surface doit être directe et que la structure syntaxique profonde est le témoin de cette correspondance (c'est-à-dire la structure de dérivation en termes plus techniques). En raison de ce statut, elle joue un rôle majeur dans le paraphrasage et la caractérisation des fonctions lexicales.

This paper defends an apparently paradoxical point of view: The deep-syntactic structure is a fundamental representation of a sentence, but it should not be considered as an intermediate structure in the meaning-text correspondence. We argue that the correspondence from the semantic level to the surface-syntactic level must be direct and that the deep-syntactic structure is the witness of this correspondence (i.e. the derivation structure in more technical terms). Due to this status, it plays a major role in the paraphrasing and in the characterization of lexical functions.

Keywords – Mots Clés

Interface/correspondance sémantique-syntaxe, structure de derivation, structure syntaxique profonde, fonction lexicale.

Semantics-syntax interface/correspondence, derivation structure, deep-syntactic structure, lexical function.

1 Introduction

We consider the deep-syntactic structure as the most problematic representation of a sentence in the Meaning-Text theory [MTT]: It plays a central role in the theory (notably in the paraphrasing rules system and in the encoding of lexical functions) but it certainly is one of the less clearly defined representations. Moreover, the deep-syntactic structure is still defined

after the semantic and the surface-syntactic structures. For instance, Mel'cuk 2003 (following Mel'cuk 1964 or 1988a:105-49) claims that there are three major types of dependency relations between wordforms in a sentence: semantic dependencies (= predicate-argument relations), syntactic dependencies and morphological dependencies (agreement, government and congruence). Syntactic dependencies are surface-syntactic dependencies in this case, that is dependencies between the actual wordforms of the sentence considered as separate units. We do not know any satisfying definition of the deep-syntactic dependencies. The best definition we could lay our hands on is "A deep-syntactic relation represents a FAMILY OF SYNTACTIC CONSTRUCTIONS of the same structural type, regardless of their semantic content" (Mel'cuk 1988a:65, emphasis is his), followed by a list of example. Even this very short definition is unacceptable. Let us take the syntactic relation 'II' as an example: It covers a non-homogenous family of surface-syntactic relations (direct object, indirect object, oblique complement …), while the indirect object is covered by both the deep-syntactic relations II and III (*Pierre parle à Marie*$_{\text{II}}$ 'Peter speaks to Mary'; *Pierre donne un livre à Marie*$_{\text{III}}$ 'Peter gives a book to Mary').

The major problem of the definition shows up when semantic and surface-syntactic dependencies mismatch as in *Peter is drinking a glass of beer*, which can be glossed by 'Peter is drinking beer in the quantity of one glass'; for such a construction, Mel'cuk 1974 proposes the following deep-syntactic relations: DRINK —II→ BEER —ATTR→ GLASS, favoring the semantic dependencies. In more recent works, he considers that deep-syntactic dependencies must coincide with surface ones, giving us DRINK —II→ GLASS —I→ BEER.

One of the arguments for the deep-syntactic representation is that it is a necessary intermediate level between the semantic and surface-syntactic representations, and not considering it will complicate the (writing of the) semantics-surface-syntax correspondence rules. We believe exactly the opposite. I do not know of any complete description of phenomena with mismatching between the semantic and surface-syntactic levels in the standard MTT. Even constructions such as *The chicken is eaten by Mary* are uselessly complicated by the passage through the deep-syntactic level: Triggering the passive voice in the semantics-deep-syntax correspondence needs to know if the verb is passivizable, that is, if its second actant is a direct object, while this information is normally only consumed in deep-surface-syntax correspondence (when a deep-syntactic relation is associated to the direct object surface-syntactic relation). If we do directly the correspondence from the semantics to the surface syntax, we cannot know if a verb we choose has or not a direct object and if the passive can or not be triggered (see for instance our treatment of *tough*-movement in Section 4). Another recurrent problem comes from the fact that a subordinated verb can be finite or infinite: Its finiteness depends on the government imposed by its governor (*Peter thinks that Mary is sleeping* [finite] vs. *Peter wants Mary to sleep* [infinite]), which is normally triggered in the deep-surface-syntactic correspondence, but this information is necessary at the deep-syntactic level in order to control if tenses are triggered or not.

Another argument for the deep-syntactic structure is its central role in paraphrasing (Mel'cuk 1988b) and in the characterization of lexical functions. In spite of all we said before, we agree with this point of view. But how can we use (and correctly define) the deep-syntactic structure without considering it in the meaning-text correspondence?

The solution comes from the comparison with another framework, Tree Adjoining Grammars (TAG, Joshi 1987). In TAG, grammar rules (corresponding to MTT correspondence rules) are

elementary structures associated with the surface realization of the semantic units of the sentence (that is lexemes or idioms with their government pattern). The combination of the elementary structures associated to the different parts of the sentence allows us to compute the structure of the whole sentence (including the different levels of representation of the sentence). The process of combination (i.e. information on which and how elementary structures combine) can be stored in a structure called the derivation tree (Vijay-Shanker 1987). Rambow & Joshi 1992 have shown that the TAG derivation is very close to a deep-syntactic tree (Candito & Kahane 1998 have nevertheless pointed out some problems in the interpretation of TAG derivation tree in case of mismatch between the semantic and surface-syntactic structures, as in extraction phenomena). It is possible to interpret the MTT correspondence rules as elementary structures (as proposed by Nasr 1995, 1996 and Kahane 2002) and to associate a derivation structure to the correspondence between the semantic and the surface-syntactic structures of a sentence. This gives us a structure equivalent to the deep-syntactic structure (in the simpler cases). Therefore we can define a structure equivalent to the deep-syntactic structure without presupposing it. Clearly, this structure has a fundamental theoretical role: It shows how the linguistic signs combine to yield a sentence. The derivation structure also plays a central role in paraphrasing: Paraphrasing consists in expressing the same meaning in another way, that is, using other signs to express the same meaning. Therefore, a theory of paraphrasing (as proposed by Mel'cuk 1992) explains which combination of signs can be replaced by which other combination and this can be checked on the derivation structure.

Section 2 shows how to interpret an MTT correspondence rule as an elementary structure and how to associate a derivation structure to an actual correspondence. Section 3 is devoted to the description of lexical functions. Section 4 investigates what happens when the semantic and the surface-syntactic representations mismatch.

2 Semantics-syntax correspondence and derivation structure

We will now propose a fragment of a grammar for the semantics-syntax correspondence. As said in the introduction, we consider only one syntactic level in our meaning-text correspondence. Our syntactic structure is the MTT surface-syntactic dependency tree, following Tesnière 1959 and most of the contemporary theories (for instance, HPSG (Pollard & Sag 1994, Sag & Wasow 1999) considers a semantics-syntax interface between two levels of representation more or less equivalent to the levels of representation considered here). An MTT correspondence rule will be interpreted as a unique structure (such a structure mixing two structures is called a *product* structure in mathematics). Figure 1a shows the correspondence rule between the semantic predicate ‘eat’(x,y) and the French verb MANGER.[1] The semantic arguments x and y of ‘eat’ correspond respectively to the subject (*subj*) and to the direct object (*dobj*) of MANGER and both of them must be nouns. These node-to-node correspondences are indicated by dashed lines. The features →v and →m indicate that the verb must be combined with a voice and a mood.

Figure 1b gives exactly the same information as Figure 1a, but the correspondence rule is replaced by a product structure. The syntactic structure is favored and kept and the semantic

[1] Semantemes are language-specific; however, we translate the French semantemes for the sake of clarity.

structure is encoded via the features /sem/ for a semantic node and /arg/ for a semantic dependency. The correspondence between a semantic node and a syntactic node is encoded by simply labeling the syntactic node with the /sem/ feature of the corresponding semantic node.

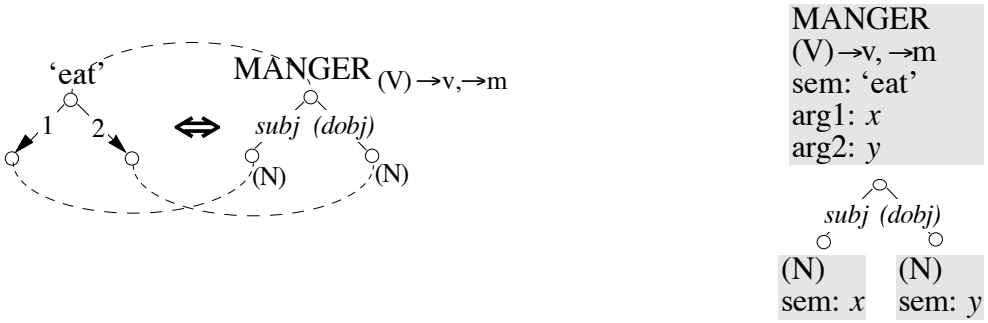

Figure 1: Two representations for the rule for MANGER 'eat'

Figure 2 show the derivation of the French sentence *Zoé essaye de manger la pomme* 'Zoé is-trying to eat the apple'. Each rule can be interpreted as a linguistic sign, associating a semanteme with a syntactic configuration. The signs of the semantics-syntax correspondence are noted by an underlining; lexical signs are in uppercase and grammatical signs in lowercase.

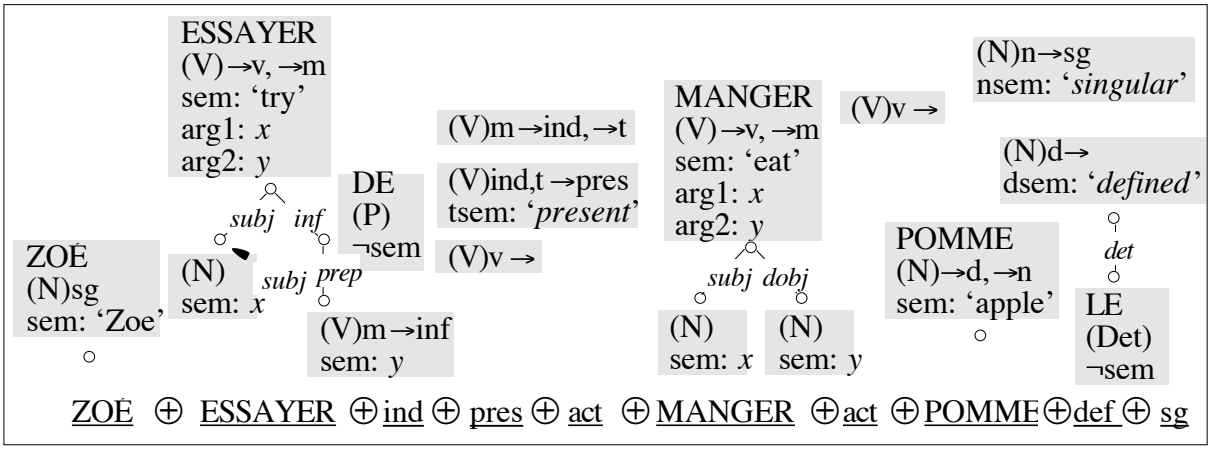

Figure 2: Derivation of *Zoé essaye de manger la pomme*
'Zoe is-trying to eat the apple'

The lexical sign ESSAYER 'try' combines with three grammatical signs: the active voice, indicative mood, and the present tense.[2] The sign active just fills the voice request (the request →v is annulated by v→). The sign indicative fills the mood request (m→) and introduces a mood grammeme (ind) and a tense request (→t). The sign present fills the tense request (t→) and introduces a tense grammeme (pres) and a grammatical semanteme '*present*' whose argument is the semanteme associated to the verb it combines with.[3] The sign ESSAYER also introduces government requirements on its actants: It requires its second actant to be a verb in the infinitive and to share its potential subject with the subject of ESSAYER.

The treatment of raising verbs (such as SEMBLER 'seem') and control verbs (such as ESSAYER 'try') forces us to enrich the formalism. We must indicate, in the structure associated with such a verb, that its subject is also the potential subject of its verbal complement. In order to ensure that, we introduce, in the structure of these verbs, a particular

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[2] Our category of mood mixes two inflectional categories: the finiteness (finite, infinitive, participle) and the mood proper when the verb is finite.

[3] Grammatical semantemes are written in italic due to their particular interpretation: The semanteme '*present*' is not the meaning of the word PRESENT but of a grammatical sign called *present*.

dependency, which we call a *quasi-dependency* and represent by a dashed arrow. A quasi-dependency unifies with an ordinary dependency (of same function) giving us a quasi-dependency. In Figure 2, the *subj* dependency of MANGER 'eat' must combine with the *subj* quasi-dependency of ESSAYER, ensuring that they share a semantic argument and that MANGER, which is infinitive, does not realize a *subj* dependency.

At this point, we must note an important difference between our rules and traditional MTT rules. The rule MANGER of Figure 1 is not exactly a correspondence rule but rather a rule of *potential* correspondence. It just says that the first actant of MANGER is potentially realized as subject. But the combination with other rules can change this initial destination. For instance the same rule MANGER is used for the passive voice but the sign passive will change the potential subject into a agent complement and the potential direct object into a subject (see Kahane 2002).

The lower part of Figure 2 gives the result of the combination of the signs (i.e. the *derived structure*) and the derivation structure. The signs combine by unification of features. Variable are used to indicate that several features share the same value; for instance, the features /arg1/ of ESSAYER and MANGER and the feature /sem/ of ZOÉ share the same value 'Zoé'. The derived structure contains both the semantic graph and the syntactic tree of the derived sentence.

The derivation structure encodes the derivation process: It says which signs combine together and how they combine. We use the graphical conventions given in Figure 3. The derivation structure indicates if there is a semantic and/or a syntactic dependency between two signs that combine. We only retain the labels of the semantic dependencies. Grammatical signs are noted in subscript of the lexical sign they combine with. With these conventions our derivation structure looks like a deep-syntactic structure of MTT. But contrary to a deep-syntactic tree, only the core of the structure is a tree: Our structure is rather a (partially) hierarchized graph. For instance, in the derivation of Figure 2, we indicate the semantic dependency without syntactic counterpart between MANGER 'eat' and ZOÉ 'Zoe', rather to consider, as in the traditional MTT analysis, an artificial deep-syntactic node depending on MANGER and corefering with the first actant of ESSAYER 'try'.

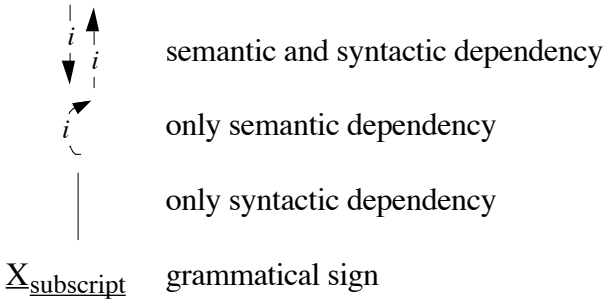

Figure 3: Graphical conventions for the derivation structure

There is another notable difference between the derivation tree and the deep-syntactic tree: We use the semantic numbering for the dependencies, even for passives. In order to indicate that the passive has changed the syntactic oblicity, we must retain the syntactic oblicity in the derivation structure by adopting, for instance, Tesnière 1959's convention consisting in ordering the syntactic codependents in the tree following the oblicity order (Figure 4).

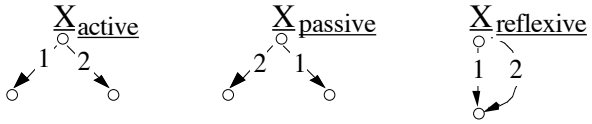

Figure 4: Derivation structures for active, passive and reflexive voices

3 Idioms and lexical functions

Let us begin by the description of idioms (Figure 5, on the left). An idiom is a configuration of several syntactic nodes that correspond to a unique semanteme. We attach this semanteme to the root of the corresponding syntactic configuration. All the other nodes can be considered to have no meaning (¬sem); this precludes them from being modified, because a modifier requires its governor to have semantics and to be its semantic argument.

We give in Figure 5 (on the right) the description of À LA FOLIE 'to the madness', which is a value of the lexical function Magn for AIMER 'love'. We call such a sign a *collocate*.[4] The sign À LA FOLIE expresses the meaning 'intense' and requires its governor (which is its semantic argument) to be the verb AIMER. The lexical function Magn is a generalization of such signs, which expresses the vague meaning 'intense'/'big'/… and are lexically constrained.

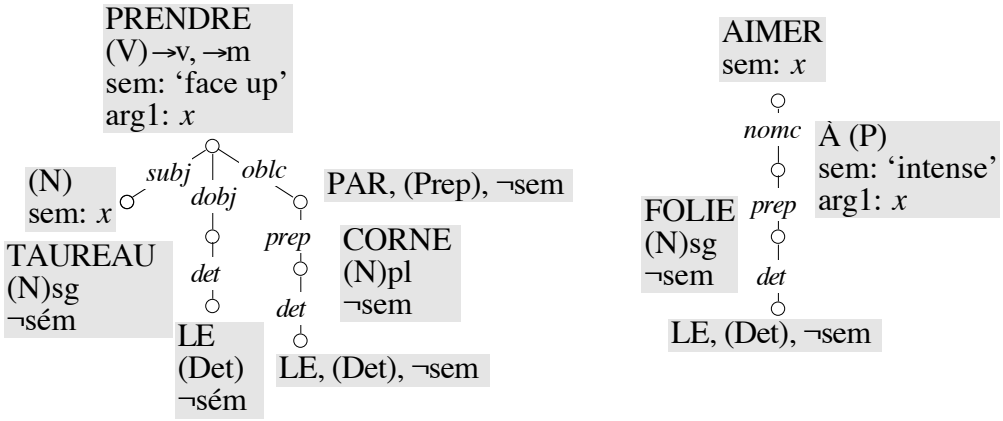

Figure 5: The idiom PRENDRE LE TAUREAU PAR LES CORNES
'take the bull by the horns' = 'face up' and the collocate À LA FOLIE 'to the madness'

Figure 6 gives the rules for three verbal collocates: Oper_1(*doubt*) = *have*, Real_2(*examination*) = *pass*, IncepLabor_{21}(*revulsion*) = *drive*. HAVE is a light verb: It has no meaning, it just allows the verbalization of DOUBT. Nevertheless, we must attribute it the /sem/ value of its base in order to ensure that in the derivation of *I think that Pater has a doubt* 'doubt' becomes the semantic argument of 'think'. PASS is a full verb with two semantic arguments; its first argument is the second argument of its second argument. DRIVE

[4] Note that À LA FOLIE is also an idiom, because the whole configuration expresses the meaning 'intense'. But, although *aimer à la folie* is a collocation (the choice of *à la folie* is controlled by AIMER), we can treat it as a compositional configuration and not an idiom.

is full verb expressing a unary predicate ‘begin’; therefore its two first syntactic dependent are not its semantic arguments, but they are semantic arguments of its third syntactic dependent.

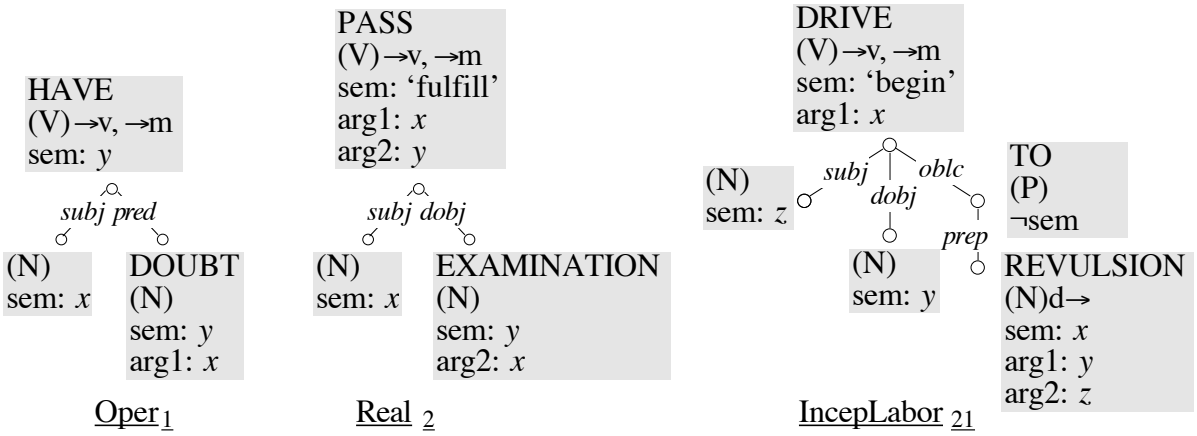

Figure 6: Collocates HAVE, PASS, and DRIVE

The encoding of lexical functions is based on both the meaning they express and their syntactic frame (see Kahane & Polguère 2001, who propose an explicit encoding based on the semantic content and the syntactic frame and show how the traditional (or algebraic) encoding can be derived from it). In other terms, the encoding of lexical functions will be based on the derivation structure: Two collocates are considered to be the value of a same lexical function if they express the same (rather vague) meaning and have the same derivation structure. Figure 6 gives the derivation structure corresponding to some lexical functions (see Alonso Ramos 2003 for a similar work in traditional MTT framework). Func$_0$, Func$_i$ and Oper$_i$ are light verbs; if they have no meaning, their syntactic dependents cannot be semantic arguments. Nevertheless, they have a particular relation with one of their syntactic dependent, the base word that controls the collocation, whose meaning they bear (see comments of Figure 6). Incep express the meaning ‘begin’ and has only one semantic argument.

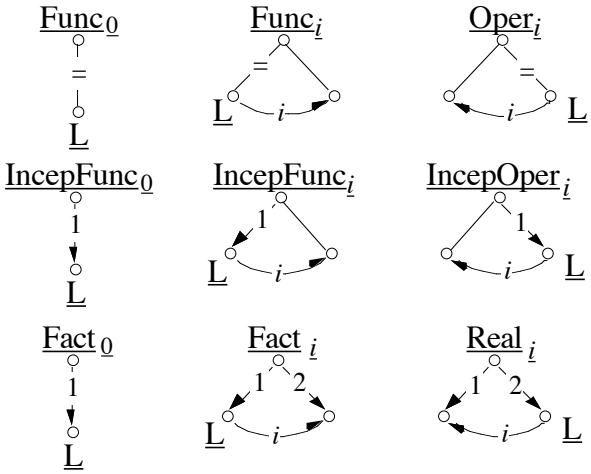

Figure 7: Derivation structures of some lexical functions (L is the base word)

4 Semantics-syntax mismatches

We finish this paper by a description of the *tough*-movement in French, illustrated by *un livre facile à lire* 'a book easy to read' (Figure 8). This construction expresses the meaning 'a book such that to read it is easy'. Therefore the semantic dependencies remain the same than in *Lire ce livre est facile* 'read this book is easy': 'book' is second argument of 'read' and 'read' is the unique argument of 'easy'. The difficulty of this construction comes from the mismatches between the semantic and the syntactic dependencies, because the syntactic dependencies between LIRE and LIVRE and between LIVRE and FACILE do not correspond to semantic dependencies. Nevertheless, in the description we propose, the structures of the signs FACILE, LIRE and LIVRE are their usual structures. All the difficulties are assumed by a structure associated to the construction, which we call Adj À Vinf and which resembles an adjectival voice (in the sense that, as a verbal voice, it entails a redistribution of the arguments).[5] (The same analysis should not be possible in English, where, contrary to French the *tough*-movement is non-local: **un livre facile à demander de lire* vs. *a book easy to ask to read*.) Our approach differs from certain descriptions (such as for instance Kayne 1974-75) that propose to derive *ce livre est facile à lire* 'this book is easy to read' from the impersonal *il est facile de lire ce livre* 'it is easy to read this book' by an object raising (with an alternation of the preposition in French difficult to explain). In our approach the two constructions are obtained parallelly by the combination of the adjective with two different grammatical signs.

[5] The fact that some information corresponds to a construction, rather than to particular lexical units, is used in some frameworks for justifying phrasal rules and phrase structures (Ginzburg & Sag 2000). We see with this example that it is possible to consider signs associates to constructions without considering phrasal descriptions.

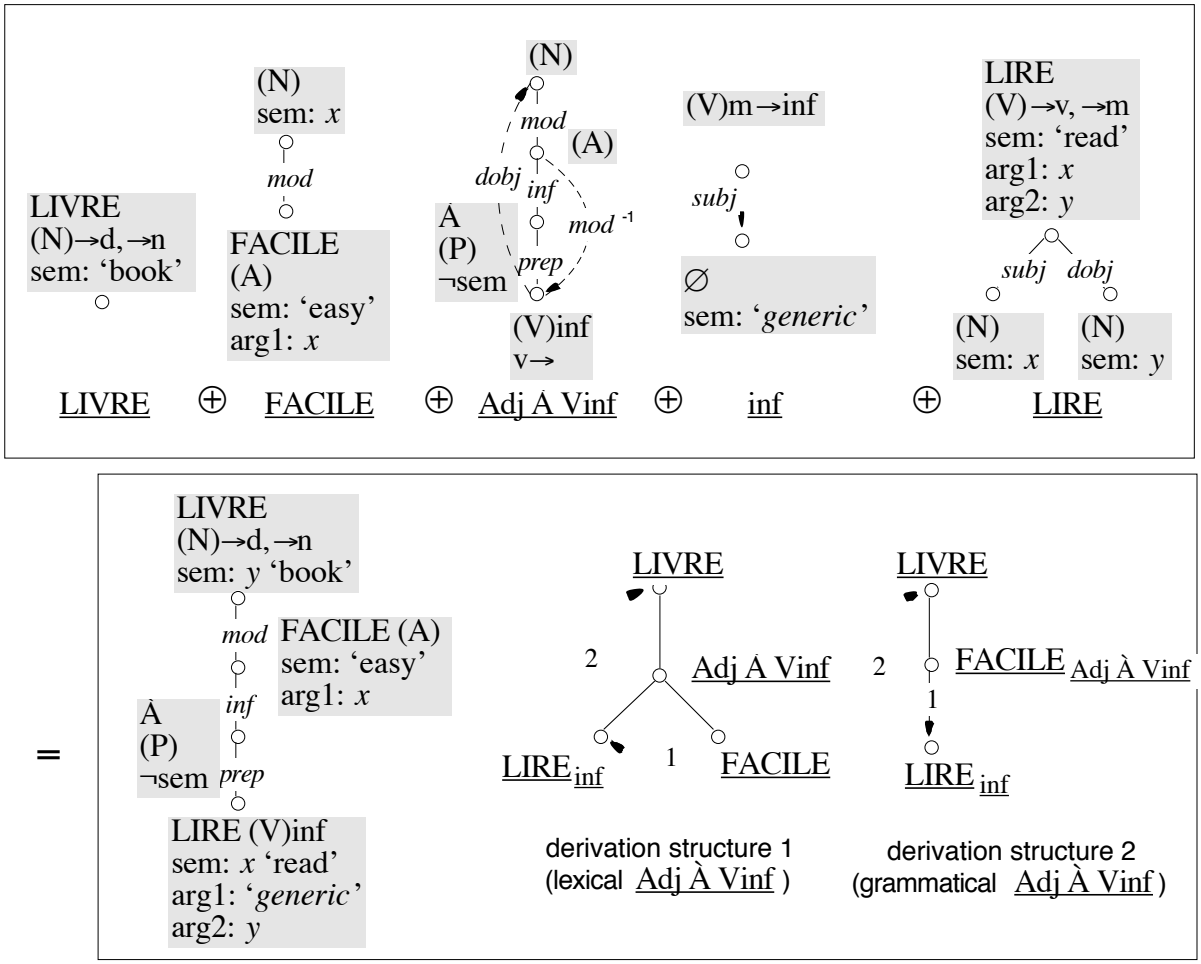

Figure 8: Derivation of *un livre facile à lire* 'a book easy to read'

We need a rule for the infinitive when it is not imposed by the subcategorization as in *Voler est un délit* 'to steal is a crime' or *un livre facile à lire*. This infinitive morpheme must block the realization of the subject of the verb and attribute a semantic content, which we call '*generic*', to the argument potentially realized as a subject. We are not concerned here by the interpretation of '*generic*'; the semantics-syntax correspondence must only ensure that in such construction the potential subject of the verb receives this particular meaning.

The lower part of Figure 8 gives two derivation structures. In the first one, Adj À Vinf is treated as a lexical sign and occupies a node; in the second one, it is treated as a grammatical sign. The deep-syntactic tree proposed for this sentence (LIVRE —ATTR→ FACILE —II→ LIRE)[6] can be compared to the latter derivation structure, but it is clearly only a poor approximation not very useful as an intermediate representation.

[6] Note that following Mel'cuk's conventions, the first argument of FACILE must become its second deep-syntactic argument because it is a modifier and its first deep-syntactic "actant" is its syntactic governor. It is clear that it does not make any sense here.

5 Conclusion

This paper contains essentially two results. The first result is a fragment of a semantics-syntax interface based on MTT and using a unification formalism. This modeling includes a treatment of lexical signs, grammatical signs, lexical functions and constructional signs (such as Adj À Vinf).

The second result is the definition of a structure, the derivation structure, which can be compared with the deep-syntactic structure. We think that our structure is better defined than the deep-syntactic tree and it can play a central role in the definition of lexical functions and paraphrasing rules We do not think that such a structure is needed as an intermediate structure in the meaning-text correspondence, but we think that our study might help everyone who wants nevertheless to consider such a structure.

We can finish by giving some good properties of the formalism we propose here.

First, our formalism is nearly associative, i.e. the rules can combine in whatever order. The only constraint concerns the grammatical (and constructional) signs: A lexical sign must combine with its grammatical signs before combining with other lexical signs.

Second, the formalism is powerful enough for allowing us to use the same structure for different uses of a lexeme (while a formalism such as TAG requires a different structure for each use of a lexeme).

We can note that the syntactic roles on the dependencies play an important role in our grammar. For instance the *dobj* relation validates the combination of a verb with the construction Adj À Vinf. It will also validate the combination with the passive voice, the accusative clitic pronoun or the agreement with past participle. This extensive use of the syntactic roles in the rules is only possible because we directly do the correspondence from the semantics to the surface-syntax.

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