THE RADICAL LEXICALISM AND THE PLACE OF SYNTAX IN CATEGORIAL GRAMMARS

Béatrice Godart-Wendling
Centre National de la Recherche Scientifique, Paris

RESUMO: *Este artigo analisa as gramáticas categoriais com o objetivo de responder às questões: "tudo pode acontecer no léxico?" e "existe uma divisão real de trabalho entre os processos sintático e lexical?" A autora conclui que as Gramáticas Categoriais Gerais são ainda sintaxes de concatenação com as capacidades expressivas limitadas das gramáticas que não levam em conta o contexto.*

ABSTRACT: *This article analyses categorial grammars with the aim of answering the questions: "can everything happen in the lexicon?" and "is there a real division of labour between lexical and syntactic processes?" The author concludes that Generalized Categorial Grammars are still concatenation syntaxes which have the limited expressive capabilities of context-free grammars.*

Introduction

One of the most characteristic features of contemporary categorial grammars is that they take to its extreme the move towards lexical syntax. The syntactic behaviour of any word is directly encoded in its lexical category specification. The result of this is that atomic or complex categories[1] replace phrase-structure rules and thus make a separate grammar rule component unnecessary. As far back as 1953, Yehoshua Bar-Hillel (1915-1975) pointed out the significance of this theoretical possibility of categorial grammars when he wrote: "the main economy produced by this method lies [...] in that it enables us to dispense completely, at least in principle, with syntactic statements" (1953: 61). Until 1980 this theoretical tenet, called "radical lexicalism" (L. Karttunen, 1989) or "lexical maximalism" (R. Oehrle, 1981), contrasted categorial approach with Chomskian theory. This explains why Wojciech Buszkowski (1950), one of the most famous theoreticians of categorial grammars, considers that:

> From the standpoint of formal linguistics, Categorial Grammars constitute a refinement of Chomsky's Phrase Structure Grammars, since – in opposition to the latter – the former assign an internal structure to category symbols (non-terminals). (1988: 69)

With the elaboration of more recent theories of syntax, as Generalized Phrase Structure Grammar (GPSG, G. Gazdar, E. Klein, G. Pullum & Sag 1985) or Head-Driven Phrase Structure Grammar (HPSG, C. Pollard & I. Sag 1988), which use structured categories of various kinds, there is yet a point of convergence with categorial approach, but none of these theories go as far as categorial grammars in incorporating the whole range of linguistic information in lexical categories. So, the problem to solve is the following: can everything happen in the lexicon? Is there a real division of labour between lexical and syntactic processes?

In the first part of this paper, I will show how categorial grammars encode virtually in the lexical entries of words all the information about how words are combined into phrases. This study will allow to understand the algebraic structuration of categories assigned to the words in the lexicon. In the second part, I will point out that this categorial conception results from the integration in the lexicon of rules originally created to account for some syntactical phenomena. So the difficulty lies in the justifications to provide in order to defend the idea that syntactical rules could change of status and become, with the same form, lexical rules. Finally I will tackle the difficulties suited to this kind of approach and I will show how the strategy of minimal type assignment, which infringes Montague's theory, succeeds to solve the problem of the explosion of types assigned to the words in the lexicon.

1. The formation of lexical categories

The process of lexicalisation of the syntax started at the beginning of the eighties with the elaboration of Generalized Categorial Grammars which lay down on the Lambek calculus (1958) enriched with combinatory operations in the form of a type-shifting calculus. The main reason which leads to shift the explication from the syntactic component to the lexicon is that Generalized Categorial Grammars don't use as GPSG a transformational component because they are surface-oriented. So, this theoretical choice requires that word order to be inscribed in the category structures assigned to the lexical items.

The difference with GPSG is that Generalized Categorial Grammars take the move towards lexicalism a step further and eliminate the phrase

structure component itself. In order to carry out this elimination, the category system provides an infinite supply of possible category objects, recursively construed out of two small finite sets, a set of basic categories (as for instance, S, N, NP, AP, PP) and a set of category-forming connectives (/, ., \). If the product connective "." is the concatenation operator, the division connectives form functor categories. A functor category (X/Y or X\Y) is associated with an incomplete expression: X/Y will form an expression of category X in combination with an expression of category Y. So, the orientation of the connective indicates the mode of combination of a functor category (in the cas of left-division \, the functor looks for its argument to the left).

With functor category, we can show how the recursively structured category objects mirror phrase structure information, and encode the language-specific properties of lexical items as to directionality requirements. For example, consider a transitive verb which is an incomplete expression that will project a VP if it finds a direct object to its right: hence the category assignment VP/NP. So, instead to put the Phrase Structure rule VP ® V NP, we have only the category VP/NP.

Furthermore, in order to deal with phenomena of inflectional morphology, the unanalysed basic categories must be further decomposed into feature-value sets, as is standardly done in feature theories. In "On the Relationship between Word-Grammar and Phrase-Grammar", Emmon Bach (1929) has shown how the feature decomposition of basic categories can be added to the recursive build-up of complex categories and has also demonstrated how morphological phenomena of agreement and government can be related to the function-argument structure.

Then, functor categories symbolize completely clear combinatory rules and they are, unlike basic categories, syntactically "active" since they allow the formation of new constituents. Therefore, as Michael Moortgat (1954) underlines it, the lexical entries of words encode all the information about how words are combined into phrases:

Syntactic information is projected entirely from the category structures assigned to the lexical items. In its most pure form, Categorial Grammar identifies the lexicon as the only locus for language-specific stipulation. The syntax is a free algebra: a universal combinatorics driven by the complex category structures. (1988a: 1).

Furthermore, the algorithm used in order to determinate if a word sequence forms a grammatical sentence, turns out very simple: its only indication is that we have to try to simplify a functor category with an adjacent argument. So, it becomes possible to replace the set of rewriting

rules by only one universal rule applicable to all natural languages. This general reduction scheme, called Application rule[2], is:

(forward) X/Y : *f*, Y : *a* => X : *f(a)*
(backward) Y : *a*, Y\X : *f* => X : *f(a)*

This rule which "embodies the ideal of lexicon-driven syntax" (Moortgat, 1988a: 12) allows a compositional calculus of sentence meaning in establishing a correspondence between the syntactic rule and functional application in semantics. Furthermore, in avoiding distinguishing syntax from semantics as two autonomous levels of representation, Generalized Categorial Grammars do not have to resolve some mismatches between these levels in adding — as do standard generative approaches — readjustment principles to govern the mapping between them.

2. The move towards lexical rules

In 1958 Jim Lambek (1922) added to categorial grammar syntactical rules in order to describe some new empirical facts. These syntactical rules will change of status at the end of the eighties in being incorporated in the lexicon as truly lexical rules3. For instance, the rule of Composition:

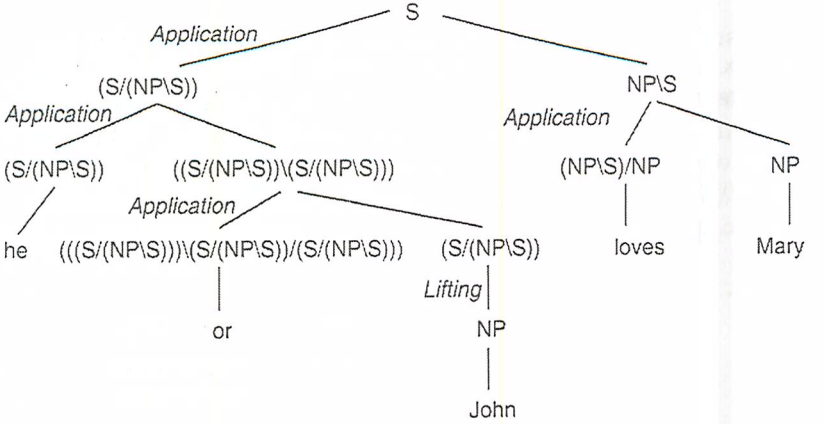
(forward) X/Y : *f*, Y/Z : *g* => X/Z : *v.* *f(g(v))*
(backward) Z\Y : *g*, Y\X : *f* => Z\X : *v.* *f(g(v))*

was elaborated to account for two forms of pronoun (he / him) in English (in a sentence like *he loves him*). The Lifting rule which is:

(forward) X : *a* => Y/(X\Y) : *v.* *v(a)*
(backward) X : *a* => (Y/X)\Y : *v.* *v(a)*

allows to resolve the problem of the substitution between a noun and a pronoun. By means of Composition, the pronoun *he* is taken to be assigned the category s/(n\s) and the object pronoun *him* is specified as (s/n)\s. The problem with this higher-order type assignment to (subject and object) pronouns is that the pronouns and the ordinary NP's (like *John*) now have a different type. But, pronouns and NP expressions can be conjoined (*he or John loves Mary*, *John loves him or Mary*), and conjunction requires the types of the conjuncts to be equal. The Lifting rule allows the second-order pronoun types to be accessible from the 0-order NP type. In other words, an unmarked noun NP can take on either

of these specified pronoun types (subject or object). The syntactic derivation of a sentence like *he or John loves Mary* is then as follows:



So, Composition and Lifting rules have as a consequence that an (even non-ambiguous) expression is no more assigned to one category (type), but to a family of related categories (types). These rules — called type-shifting rules — make it possible for a type to adapt to its context, and to assume an appropriate shifted type so that an Application reduction goes through. So, these rules (elaborated to solve syntactic problems) will be transferred without any change of form to the lexicon where they get the status of lexical rules.

The arguments which justify this move towards the lexicon can be found in Moortgat (1988b). In this paper Moortgat argues in favour of a lexical composition rule in studying three phenomena of word-formation: morphological restructuring, complement inheritance and what he calls the atom condition on verb-raising clusters. The problem with these word-formation processes is that they have phrasal scope semantically and hence they should be derived from syntactic phrases. But in Generalized Categorial Grammar, the lexicon is an autonomous component and "the lexical rules cannot be fed by syntactic rules" (1988b: 323). Considering Aronoff's Conjecture which states that words are derived from existing words, Moortgat shows that the type-shifting theory "allows to reconcile phrasal scope of affixes with the fact that affixation is word-based morphologically" (1988b: 323). If we only consider the morphological restructuring, Moortgat's goal is twofold: — synchronically to allow for the one-step derivation by means of a composite affix in cases where the intermediary step is not an existing word and — diachronically to offer an explanation for the birth of new affixes, by lexicalisation of complex affixes. Comparing the German words *Spielerin* ("female person

who plays") and *Gebärerin* ("female person who gives birth"), Moortgat writes[4]:

> The suffix *-er* turns verbs into nouns; its lexical type is V\N. The suffix *-in* forms feminine nouns parallel to masculine personal substantives; it is categorized as N\N. In a standard categorial system with application as the only reduction rule [...] there is only one way to derive the complex form *Spielerin*: the affixes *-er* (V\N) and *-in* (N\N) have to combine successively with a base of the appropriate type:

Spiel-	-er	-in		
	V		V\N	N\N
	N		N\N	Application
		N		Application

> When Composition is part of the combinatory possibilities, the domain of eligible bases for the affix *-in* is extended: the base can be of category N, or it can be a functor with N range, for example the noun-forming affix -er (V\N). In the latter case, *-in* can combine directly with the functor by means of partial combination [...]. The result of this combination, the composite affix -erin (V\N), can now combine with a verbal base by means of Application. [...].

Spiel	-er	-in	
V	V\N	N\N	
V	V\N		Composition
N			Application

> Now take a derivation such as *Gebärerin* ("female person who gives birth"): it is unlikely, for biological reasons, that this is an *-in* derivation from an *-er* derivation. The composite affix *-erin* allows one to derive *Gebärerin* directly from the verb stem *gebär-*, in accordance with Aronoff's dictum that words are derived from existing words. (1988b: 324)

But the problem of this lexical type-shifting theory is that it offers the possibility to assign to each word in the lexicon an infinity of types since it is in principle possible to apply several times a same type-shifting rule or to link up the application of different type-shifting rules. Then we obtain a categorial explosion which has as a consequence, as Bar-Hillel

noted it, that "there is no longer any assurance that the number of derivations is finite at all" (Bar-Hillel, 1960: 82).

3. The strategy of minimal type assignment

The first solution to the problem of the infinite categorization was proposed in the paper "Generalized Conjunction and Type Ambiguity" (B. Partee and M. Roots, 1983)[5]. In this paper, the authors argue against the uniform category-type correspondence[6] advocated by Richard Montague (1930-1971) in "The Proper Treatment of Quantification in Ordinary English". This uniformity has as a consequence that we have to assign to "*all* members of a given syntactic category the "highest" type needed for *any* of them" (Partee and Roots, 1983: 366). Instead of that, the strategy of minimal type assignment specifies for each expression "its minimal type" in the lexicon. This minimal type corresponds to the simplest type to base an adequate semantics on. So all expressions are interpreted at the lowest type possible, invoking derived higher-order types only when needed for type coherence. So the type-shifting rules do not apply automatically: they are invoked only to resolve a type-clash: when two types cannot combine because they do not match, the minimal type-shift is applied to achieve type coherence. Partee and Roots' strategy is thus the following:

> — Provide lexical rules furnishing "higher"-type homonyms for "lower"-type elements
> — Posit as a processing strategy that all expressions are interpreted at the lowest type possible, invoking higher-type homonyms only when needed for type coherence. (1983: 367-368).

So, if we want for example to account for the conjoinability of two extensional verbs, we enter each verb lexically in its minimal type (NP\S)/NP (or in Montague notation <e, <e, t>>). This strategy allows to show the good formation of the expression "catch and eat". But if we want to account for the conjoinability of intensional and extensional verbs (*need and buy*), we apply a lexical rule which allows the extensional verb (*buy*) to get a homonym of higher type (which will be compatible with the type of the intensional verb). This is this solution which will be adopted by Generalized Categorial Grammars.

4. Conclusion

After this study, it seems at first sight that Generalized Categorial Grammars have succeeded to do without a syntactical component and

that it is possible to directly interpret semantically the lexical categories. But this point of view forgets the role of the Application reduction scheme which always ends the process of sentence checking. In categorial grammars, this reduction scheme has, contrary to the other rules, the status of a syntactical rule because it is considered as the only universal algebraic rule applicable to all natural languages. As a consequence, Generalized Categorial Grammars are still concatenation syntaxes which have the limited expressive capabilities of context-free grammars. This last consideration allows to understand the actual emergence of new categorial systems (as Lambek's pregroup grammars or Moortgat's multimodal type-logical architecture)[7] which tend to achieve the extra expressivity required by natural languages while checking the problems of overgeneration.

Notas

[1] Under the influence of Alonzo Church, categories are also called "types".
[2] We use italics to represent the semantic interpretation. The other characters symbolize the syntactic category.
[3] As testifies the treatment of passive (see E. Bach (1980) or D. Dowty (1982) versus J. Bresnan (1978)), this move towards lexical rules will be controversial.
[4] For a good understanding of Moortgat's analysis, we have inserted the syntactic derivations in his text.
[5] See also J. Groenendijk and M. Stokhof (1984) and H. Hendriks (1988).
[6] In Montague's theory, the notion of "category" is used to represent the syntactic information whereas the concept of "type" embodies the semantical content.
[7] See J. Lambek (1999), C. Casadio (2002) and M. Moortgat (1997, 2002).

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