PAULO RICARDO ABRAHÃO
ROVE LUIZA DE OLIVEIRA CHISHMAN
PUCRS - Instituto de Informática
PUCRS - Instituto de Letras
Porto Alegre - RS
Brasil

The generative lexicon and the polysemous nominals in Portuguese

Introduction

The present article aims to study the theory of Generative Lexicon(James Pustejovsky, 1995) from a specific point of view: the analysis of the nominals considered by the model as logically polysemous , such as *livro*, *cidade*, *construção* and *refeição* (book, city, construction and meal) in Portuguese.

Considering that the theory uses nominal alternations (mass-count, figure-ground, product-producer, etc) as strategy to model the lexical entries, we intend, through examples from the Portuguese, to verify the productive character of such methodology, since, for Pustejovsky, those words considered systematically ambiguous should be generated by the lexicon, and not simply listed.

Focusing in that purpose, in a first moment we will present a brief sketch of the theory emphasizing the specific treatment that the nominals receive. Using the called Qualia Structure - that is essentially an argument structure for the nominals - Pustejovsky comes to reject the view that the lexicon should have a static and enumerative organization.

In a second moment, we will focalize the resources the theory has to represent that class of nominals. Our purpose is to verify the way the lexical rules operate on the representations contained in the lexical entries to generate the correct interpretation of a logically polysemous nominal.

Then, the present study, besides illustrating the theory exploring examples of the Portuguese, also intends to verify how the model properties are desirable in computational systems that process the natural language in semantic level.

1. The Generative Lexicon Theory

James Pustejovsky models the lexical semantic using the principle that the lexicon cannot be presented as a static group of words. According to the author, just a more complex model, formed by a system that represents in an expressive way the knowledge lexical in conjunction with inference mechanisms, is able to express a set of linguistic generalizations - independently of lexical relationships as synonymy, antonymy, hyponymy and meronymy - that can be generated by the system; consequently, it would result in a lexicon with a smaller number of entries.

According to this perspective, instead of adding new word and increasing new properties, the lexicon should be able to infer systematically new uses of known words and its properties. Pustejovsky refers the theories with that potential as being opposed to the standard view, that treats the lexical ambiguity using multiple lists, and to the view guided exclusively by the context, that just defines the meaning pragmatically. The methodological strategy adopted by Pustejovsky is guided by the thesis that the semantic explanation of the grammatical classes can organize the system. Instead of registering the meaning alterations pointed by the common theories, the important aspect is to consider the logical relationship among the senses that an item lexical can assume as one of the responsible elements for the simplification of the entries.

Rather than presenting the lexical items based on features sets or connections nets, the model organizes in structured forms on which the generative mechanisms operate to build the meanings. There are four representation levels for that purpose:

a) **Argument Structure**: it indicates how the arguments are realized syntactically;

b) **Event Structure**: it identifies the event type of a lexical item and a phrase;

c) **Qualia Structure**: it contains the essential attributes of an object in structured form;

d) **Lexical Inheritance Structure**: it determines how a lexical structure is related to other structures in the type lattice.

The qualia structure, level formed by four different dimensions of the meaning[1], is presented in a complete way. Pustejovsky (1997) sketches this structure like the diagram below:

(1)

α
ARGSTR [ARG1 = x]
QUALIA [CONST = **what** x **is made of**
FORMAL = **what** x **is**
TELIC = **function of** x
AGENTIVE = **how** x **came into being**]

The qualia roles structure the knowledge and suggest interpretations in different contexts. An example of representation is illustrated in (2):

(2)

carro
ARGSTR [ARG1 = x: *objfís*]
QUALIA [CONST = *carroceira, motor, rodas*
FORMAL = x
TELIC = *dirigir* (e, y, x)
AGENTIVE = *construir* (e, z, x)]

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[1] Pustejovsky explores the Moravcsik's studies (1975) about Aristotle explanation modes to design the qualia structure.

In the example, the roles of the qualia structure of the noun *carro* (car) are not only lists of predicates. The qualia roles values contain expressions with defined types and related structures. This sort of representation is used by Pustejovsky to provide a semantic treatment more polymorphic and to allow different interpretations from lexical items in particular contexts. The qualia structure relates the types defined in the argument and event structures and it is equivalent to an expression λ (expression LAMBDA[2]). As example, the expression λ of the example (2) is presented in (3).

(3) λx[*carro*(x) ∧ ... TELIC = *dirigir*(e1, y, x) ∧ AGENTIVE = *construir* (e2, z,x)]

It's possible to notice that the qualia structure is defined on other qualia structures, forming, thus, a hierarchic net of roles, that seems to be more expressive than the IS_A hierarchies, because the generalizations and specifications are given by different dimensions and not only for the pertinence function IS_A.

Pustejovsky assign to the generative factors the ability to connect the four levels in order to supply the compositional interpretation. Through those mechanisms, it is possible to understand why the model uses a less conventional compositionality form, since the semantics of the complements can contribute significantly to the interpretation of the sentence. There are three mechanisms that act on the information supplied by the four levels:

a) **Coercion**: operation that converts an argument for the type that is claimed by a function; the strategy consists of changing the type of the complement in function of the exigency of the verb, avoiding, consequently, the need to enumerate different senses for the verb;

b) **Selective Binding**: operation of the adjective on the structure of the sentence; the interpretation of the adjective to the context depend of the semantics of the object that is refered;

c) **Co-composition**: definition of the semantic interpretation of the sentence governed by the complement; this rule allows that the meaning of a sentence is also determined from the application of the function of the argument on the verb.

2 - The Polysemous Behavior of the Nominals

The treatment assigned to the nominals illustrates the expressive power of the qualia structure. In the Generative Lexicon theory, the logic polysemy of the nominals is captured by constructions in the qualia structure of dot objects. The method consists of bringing together in a single meta-entry - a Lexical Conceptual Paradigm (lcp) - both meanings without duplicating the number of entries.

Rather than the unified types, that indicate how different qualias can become unified to form a new concept - just as it happens with the meaning of food (unification of the properties substance and edible) -, the complex types involve a deeper relationship. Nouns as book, disk and bottle illustrate how such formalism is characterized. Observe (4):

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[2] More details in Bach (1989).

(4)

livro
ARGSTR
ARG1 = x: *informação*
ARG2 = y: *objfis*

QUALIA
informação.obj_fis_lcp
FORMAL = *conter*(y, x)
TELIC = *ler*(e, w, x.y)
AGENTIVE = *escrever*(e', v, x.y)

It is important to observe that the entire dot object made reference to the qualia of the lexical structure, presenting a " containment " relation that connects both senses. Pustejovsky calls endocentric this class of complex type nominals. This kind of representation becomes possible considering the capacity of the model in choosing just some parts of the meaning of an item lexical to satisfy the selectional restrictions of a function. Consider (5):

(5) a. Ele *começou* o livro.(He began the book.)

b. Ele *queimou* o livro. (He burned the book.)

A coercion operation must select, among the information contained in the lexical entry of book, the information required by the verbs to begin and to burn. In (5a), there is an event interpretation associated to the verb; in (5b), the verb chose the type as a physical object.

A different representation is presented for the polysemous nominals that denote events. Nouns as *construção*, *doação* e *publicação* (construction, donation and publication) can be highlighted, because there is a dot object composed of process and state. In that case, the relation < ,that represents a sequential relation between two subevents, e1 and e2, connects the elements. Consider (6):

(6)

publicação
ARGSTR
ARG1 = x: *ind_animado*
ARG2 = y: *objfis*

EVENTSTR
E1= e1: *processo*
E2 = e2: *estado*
Rest: <α

QUALIA
processo.resultado_lcp
FORMAL = *publicar_resultado*(e2, y)
AGENTIVE = *publicar_ato* (e1, x, y)

In (6), the types e1 and e2 appear in different values in the qualia structure, case denominated as *exocentrics* (Pustejovsky (1997: 13)).In those cases, it's possible to interpret the nominal focalizing or the result or the process of the action. Considering that this same structure of events also appears in the lexical entry of the corresponding verb (to publish), it's important to analyze how those two entries should be connected. And more: how are the morphologic subjects foreseen by the model? More specifically, how the derivational morphology aspects are incorporated by the formalism?

Pustejovsky (1997: 14) admits that the semantic contribution of affixes as *-ion* (examination) is an interesting topic, since it is a highly productive morphologic process; however, he doesn't suggest any way to relate semantics and morphology. We noticed that derivational morphemes could work as generative elements that consider the information contained in the event structure of the lexical entries of the verbs. Thus, an affix as *-ção* (*ion* in English), used in Portuguese to denote nouns that indicate process and state, would come to generate the corresponding nominal. Such mechanism would give us the guarantee that we can obtain the nouns *publicação*, *construção* e *avaliação* (publication, construction and evaluation) from the verbs *publicar*, *construir* e *avaliar* (to publish, to construct and to evaluate).

Certainly the theory of Generative Lexicon, having resources of that type, would achieve its main objectives, presenting a minimum number of entries and a rich production.

A third case of polysemous nominals pointed by Pustejovsky involves dot objects with different types. They are included in that class nouns as *lanche* (event.food), *acampamento* (event.place) and *exame* (event.question). We have believed that such examples are problematic, because the two dot elements can be structured from an enormous variety of relations; consequently, the model looses explanatory power.

Final Considerations

The treatment provided by the Lexicon Generative theory to the polysemous nominals reveals a basic strategy of the model: the linguistic information is applied to supply generativity to the theory. Linguistics and AI researchers have considered this aspect copiusly interesting.

Under the linguistic perspective, it's laudable the Pustejovsky's initiative of studying the semantics of nominals, since the studies traditionally have focalized just the verbal aspects. This explains the theory's predominantly descriptive character. As the sixty's generative syntax, the lexical semantics pays attention on a variety of semantic phenomena.

Considering the computational objectives, the theory seems adequate to eliminate the typical limitations of the models that don't consider the natural languages in its totality. The robust representation allows a connection with other sources of knowledge, essential quality to language processing systems.

However, in addressing how the polysemous nominals are treated by the theory, we have noticed that the formalism don't have generality. The different representations for the complex types illustrate it: it's possible to have a variety of relations connecting the types, feature undesirable.

Other important aspect is concerning about the place occupied by the morphology. Although we have just indicated that the productive capacity of the derivational morphology must be explored, this interface must be developed.

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