The Gate to Knowledge in a Multilingual Specialized Dictionary: Using Lexical Functions for Taxonomic and Partitive Relations

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Abstract

This paper presents an attempt to computerize an existing (multilingual) specialized dictionary and make it able to highlight all the relationships between terms, i.e., not only interlingual equivalences and synonyms, but also semantic and lexical relationships, such as hyperonymy, meronymy, derivation and combinatorics. Our aim is to give the user access to a maximum of information on these relationships in the most economical way. The method discussed here is the extraction of "Lexical Functions" (LFs) [Mel'cuk *et al.* 1984, 1995; Wanner 1996]. Our attention will be mainly focussed on taxonomic and partitive relations, of particular interest for terminology.

1 Introduction

Our project concerns the creation of an intelligent dictionary search system to help users finding targeted information. More specifically, it concerns the computerization of a multilingual dictionary of retailing. The main feature of this dictionary is that it has a wide knowledge base in terms of conceptual content as it provides a thorough description of concepts, the specification of semantic relations between terms in the same semantic field and some encyclopedic information.

One of the issues we were faced with was the conversion of semantic relationships between terms – expressed in natural language in the original dictionary – into a formalism that could classify these relations. Our aim was to enable users to discriminate them with the easiest functionalities while preserving the richness of the explanations.

After a brief presentation of the original printed dictionary (section 2), we will review some of the choices that were made during the computerization process (section 3). The last section (section 4) will focus on the formalization of a set of important semantic relations in terminology, i.e. taxonomic and partitive relations.

2 Presentation of the dictionary[1]

The *Dictionnaire analytique de la distribution / Analytical Dictionary of Retailing* [Dancette & Réthoré 2000] is intended for translators as well as professors, students and professionals in business and distributive trades. It targets two main objectives: to list the largest possible number of terms and to present them in a manner that facilitates the comprehension of concepts to the maximum. It is structured around 350 key concepts that are fully described in an encyclopedic style, so to speak, but with a keen effort to highlight the semantic relationships linking the terms and to explain the nuances in meanings and regional differences in usage. In addition to the 350 full-fledged articles (the main body of the dictionary), the dictionary includes a lexicon of some 3500 French and English related terms, covered in the body of the 350 articles.

As can be seen in the sample entry (ANCHOR) in Appendix a, articles include up to nine headings: The English main entry and its synonyms followed by usage marks, the French equivalent terms, a Definition, Semantic precisions, Semantic relations between the terms belonging to a single field (relationships of hyperonymy and hyponymy, quasi-synonymy and antonymy), Additional information providing extralinguistic information (historical notes or pragmatic information), Linguistic information, and finally, a French and an English context.

3 Designing a database dictionary

The design of the computerized version of the dictionary had to meet the following objectives:

a) Move from a "flat" entry to a relational model: this allows us to formally separate linguistic and semantic information and to integrate other languages (namely Spanish, German and Italian) in a modular fashion. Concretely, data related to terminological units themselves (grammatical data and information on usage as well as contexts) is stored in a specific structure. Other distinct structures are used to store conceptual data, that is definitions, semantic relationships between terms, and, finally, cross-language equivalence[2].

b) Give access to terms related to the key term: the articles in the original dictionary refer to several other terms that are linked to the key term according to various types of relationships: semantic relationships, such hyperonymy, antonymy, etc.; derivatives, and collocations. Examples (1) show typical sentences extracted from the original dictionary in which these relationships are established[3].

(1) According to life span, there is a distinction between **durable goods**, **semidurable goods** and **non-durable goods.**
A **category-killer** is a **big box store** operated as a self-service and specializing in a non-food product category.
Private brand = **Brand** attached to a product by the retailer who keeps an exclusive distribution right on the product or who grants this right to some other retailers.
Clientele = All the **customers** of a store or a service retailer.

Before **adopting** a new product, the consumer goes through a series of stages that define the **adoption** process.
The **adopter**, namely the consumer who **adopts** a product, [...].
The **label** has a **bar-code**.
The information on the **bar-code** is read by the **optical reader**.

c) Classify related terms occurring in an article by types of links with the key term : not only do users have access to related terms, but these relationships are classified. To achieve this, we used lexical functions, LFs [Mel'cuk *et al.* 1984; 1995; Wanner 1996][4]. Lexical functions appeared to be the best solutions since they allowed us to represent various types of relationships (paradigmatic and syntagmatic) via a unique formalism[5]. Examples (2) show how some relationships were captured (lexical functions cited are explained in Appendix B).

(2) **Anti**(durable good) = non durable good
Gener(private brand) = brand
Mult(customer) = // clientele
$\mathbf{S_1}$(adopt) = adopter
$\mathbf{V_0}$(counterfeiting) = counterfeit
Sing(product mix) = // product
$\mathbf{Oper_1}$(banner) = carry [ART ~]

This classification allows users to distinguish the different relations between the entry word and other lexical units that appear in the article[6]. Although lexical functions are useful to make first classifications, the users of a specialized dictionary could find this language quite esoteric. Therefore, explanations should be given in plain language in the database (this language is still to be developed).

It should also be added that users still have access to the explanations found in the original dictionary, so they can find more about the specific distinction existing between terminological units. For example, a lexical function can inform users that two terms share a hyperonymic relationship. Users must read the original explanation to find out what the basis of the opposition is (see example (3)).

(3) ***Gener(category-killer)*** = *big box store*

Original sentence

↓

*A **category-killer** is a **big box store** operated as a self-service and specializing in a non-food product category.*

4 Taxonomic and partitive relationships

Taxonomic and partitive relations are often considered central relationships in terminology, since they provide access to the hierarchical organization of knowledge. They also enable users of a specialized dictionary to capture groups of terms that are related conceptually as members of a class (taxonomic relationships) or in terms of proximity (partitive relationships).

However, standard lexical functions do not fully accommodate these relationships (this has already been noted by Grimes [1990] and Fontenelle [1997]), partly because these relationships are believed to refer to world knowledge (encyclopedic knowledge) rather than represent lexical relations. Some adaptations to the original model had to be made in order to take into account some relationships that have been found in the dictionary of retailing.

4.1 Gener, Anti and other taxonomic functions

The lexical function that captures hyperonymic relationships is the function **Gener**. Grimes [1990] also proposed the inverse function **Spec**[7] [8]. Examples (4) show how the functions **Gener** and **Spec** have been used in the project.

(4) **Gener**(debit card) = magnetic card **Spec**(store layout) = free-flow layout

Although they have not been designed for that purpose, these functions can be used to find taxonomies throughout the dictionary. Examples (5) show how terms that have the same value for **Gener** can be extracted. These terms can be defined as hyponyms of *discount store*.

(5) **Gener**(off-price store) = discount store
Gener(category killer) = discount store
Gener(liquidation center) = discount store
Gener(liquidation store) = discount store
Gener(factory outlet store) = discount store
Gener(warehouse store) = discount store
Gener(big-box store) = discount store
Gener(hypermarket) = discount store
Gener(deep discount store) = discount store

Gener and **Spec** can also be used to extract hierarchies (example 6).

(6) **Gener**(off-price store) = discount store **Gener**(discount store) = store

off-price store ⟶ discount store ⟶ store

Finally, co-hyponyms can be captured directly by means of a synonymic function, that is $\mathbf{Syn}_{\cap}$ (this function translates the relationship existing between lexical units that have common and different semantic components). Hyponyms that have a relationship of opposition can be described with the **Anti** function. Examples (7) show how these functions were implemented in the dictionary.

(7) **Anti**(horizontal integration) = vertical integration
$\mathbf{Syn}_{\cap}$(convenience good) = unsought good
Anti(anchor) = satellite store
$\mathbf{Syn}_{\cap}$(credit card) = debit card

The **Gener** and **Spec** functions allow users to generate lists of all hyponyms of any given term. However, terms pertaining to very different conceptual dimensions are put together with no discrimination: **Spec**(good) = *convenience good, unsought good, white good, brown good, durable good, non durable good*, etc. **Syn**$_{\cap}$ and **Anti** functions, on the contrary, can only bring together terms of the same conceptual level. Thus, they clarify the difference between these terms either because they are opposed or differentiated: *durable good* is opposed to *non durable good* ; *brown good* contrasts with *white good* according to the use of the product (entertaining v. cooking and washing); *durable good* contrasts with *non-durable good* according to the lifespan of the product; *convenience good* contrasts with *shopping good*, or *unsought good*, or *specialty good* by shopping habits.

4.2 Mult and other partitive functions

Only one pair of standard lexical functions captures what is considered to be a subtype of part-whole relationships[9]. **Mult** refers to a collection; **Sing**, the inverse function, refers to the member within a collection. Both functions were used in the dictionary (See examples (8)).

(8) **Mult**(item) = // assortment
Sing(factory outlet center) = // factory outlet store
Mult(tenant) = ~ mix
Sing(retailer cooperative) = // independent retailer

However, other partitive relationships were found in the dictionary that could not be captured by means of a standard lexical function. The first one is the part-whole relationship (in which the part plays a functional role). For this particular partitive relation, we resorted to the LF **Part** proposed by Fontenelle [1997]. (An inverse function could also be used to capture the opposite relation) (see examples 9).

(9) **Part**(label) = bar code
Part(checkout counter) = scale

We also used the **Part** function to describe the relationship such as the one shared by the term *shopping center* with *drugstore* and *department store*. In these particular cases, the part-whole relationship is qualified as "occasional" (when there is a department store in a shopping center, it is a part of the shopping center; however, a department store might not be there) (other examples are given in (10)).

(10) **Part**$_{occ}$(central business district) = convenience store
Part$_{occ}$(department store) = post office

Finally, we had to take into account a partitive relationship shared between a process and its phases. Examples (11) show how this particular link was described.

(11) **Phase**(adoption process) = awareness
Phase(prospection) = canvassing

5 Conclusion

At this stage of our research, we can conclude at a methodological level, that some relationships appear fairly compatible with the relationships generally captured by standard LFs, whereas others will probably require an adaptation to terminological needs (just as we had to accommodate certain partitive relationships).

On a practical level, we want to point to the huge number of links that must be established by means of lexical functions within the dictionary[10]. The dictionary contains approximately 3000 terms in English in French (terms in other languages are being added) and each term may be linked to a large number of related terms by various lexical functions.

Albeit a powerful tool, lexical functions are however difficult to use for some specific relationships expressed in the dictionary. One reason is that our definitions do not follow a rigorous lexical format, or a standardized pattern, as in the one established for example in Explanatory and Combinatorial Lexicology, providing explicit componential and actantial analysis. Another reason is because the dictionary contains encyclopedic information. Finally, even in a specialized domain – especially, in a highly culture-dependent domain such as trade –, it appears difficult to assess relations of sameness, contrast and hierarchy without blurring important nuances in meaning. This is corrected by providing the user of the computerized dictionary immediate access to the sentences (in natural language) from which the lexical function has been extracted.

We think that, despite these difficulties, lexical functions is a useful tool to highlight the semantic and lexical relationships between terms in a specialized dictionary. It is believed that, doing so, we can meet the frequent needs of dictionary users (typically translators or students in business schools) that search for both linguistic information (terms, synonyms, cross-language equivalences, derivatives and collocations) and conceptual information.

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Endnotes

[1] A more detailed presentation of the dictionary is given in Dancette [1998].

[2] Further details on the relational model can be found in L'Homme et Dancette [2001].

[3] The language of the printed dictionary is French. For the needs of this paper, we give the English translations.

[4] Lexical functions were developed within the framework of Explanatory and Combinatorial Lexicology (the lexical component of the Meaning <–> Text Theory). A lexical function captures an abstract meaning that can have many different lexical instanciations. Formally, a lexical function is written: f(x) = y; f refers to the function, x, to the key word, and y to the value of the LF when applied to a specific key word.

[5] This approach has been used by Fontenelle [1997] to formalize the content of the entries of a bilingual dictionary.
[6] Furthermore, it allows users to access words specific to the field of retailing from many different points. For example, *supermarket* appears in the article ANCHOR, but it also appears in 17 other articles (COMBINATION STORE, COMMUNITY SHOPPING CENTER, CONVENIENCE STORE, DEPARTMENT, etc.).
[7] The **Spec** lexical function is not implemented in Combinatorial and Explanatory Lexicology because it relates a lexical unit to several other ones (1 –> n). This also applies to other partitive relationships examined in section 4.2.
[8] It should be pointed out that other LFs capture hyperonymic and hyponymic relationships, that is $\mathbf{Syn}_{\supset}$ and $\mathbf{Syn}_{\subset}$ (more general or more restrictive synonyms). We resorted to the **Gener** and **Spec** functions that appear to be more compatible with terminological usage.
[9] For thorough studies on partitive relationships, see Iris *et al.* [1988] and Winston *et al.* [1987].
[10] So far, over a 1500 pairs of terms in the dictionary have been described using lexical functions.

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Appendix A

Entry extracted from the original dictionary

1. **ANCHOR, ANCHOR STORE, MAGNET (G.-B.), MAJOR TENANT, ANCHOR TENANT, KEY TENANT, LEAD TENANT, LEADING TENANT, GENERATOR STORE**

2 *LOCOMOTIVE$_{nf}$ MAGASIN$_{nm}$ PILIER (Qué.), MAGASIN$_{nm}$ PIVOT (Qué.), LOCATAIRE$_{nm}$ MAJEUR (Qué.), LOCATAIRE$_{nm}$ PRÉDOMINANT (Qué.)*

3 Définition :

Magasin d'un **centre commercial** (SHOPPING CENTER) qui se distingue des autres par sa plus grande taille et constitue le pôle d'attraction du centre.

4 Précisions sémantiques :

Les centres commerciaux sont parfois classés suivant la nature et le nombre de leurs **locomotives**.

Par exemple, dans un **centre commercial de quartier** (NEIGHBORHOOD SHOPPING CENTER), le rôle de **locomotive** est généralement assuré par un **supermarché** (SUPERMARKET) ou une **pharmacie** (DRUGSTORE).

Dans un **centre commercial communautaire** (COMMUNITY SHOPPING CENTER), ce rôle est assuré par un **magasin de marchandises diverses** (GENERAL MERCHANDISE STORE) ou un **grand magasin** (DEPARTMENT STORE) de taille réduite.

Dans les **centres commerciaux régionaux** (REGIONAL SHOPPING CENTERS), les **locomotives** sont des grands magasins, des magasins de marchandises diverses, des **grandes surfaces alimentaires** (*large food retailers*) ou des **grandes surfaces spécialisées** (*large specialty retailers*).

Les **locomotives** ont une grande influence sur la rentabilité du centre commercial, puisque ce sont d'elles que dépendent souvent le succès et la popularité du centre : les **locomotives** créent le **flux de clientèle** (TRAFFIC).

5 Relations internotionnelles :

La notion de **locomotive** s'oppose à celle de **magasin satellite** (*satellite store*) ou de **boutique satellite** (*satellite shop*), établissements de plus petite taille qui profitent du flux de clientèle créé par les **locomotives**.

Le terme *mini-anchor* (**mini-locomotive**) désigne parfois un **espace-restauration** (FOOD COURT) ou un cinéma qui a un fort **pouvoir d'attraction** (PULLING POWER).

6 Compléments d'information :

En général, le rôle de **locomotive** est assuré par des magasins non spécialisés tels que le **magasin populaire 1** (VARIETY STORE), le **grand magasin**, le **supermarché** ou l'**hypermarché** (HYPERMARKET). Toutefois, on note aujourd'hui qu'une **grande surface spécialisée minimarge** (CATEGORY KILLER) peut faire office de **locomotive** dans les **mégacentres commerciaux** (MEGAMALLS). Cette tendance reflète l'importance grandissante de ce type de commerce dans l'appareil commercial.

Il y a quelques années, un nouveau type de centre commercial est apparu : le **centre de grandes surfaces** (POWER CENTER). Il ne regroupe que des **locomotives** ou des **magasins de destination** (DESTINATION STORES).

7 Informations linguistiques :

– **jouer le rôle de locomotive** : *anchor*$_V$
– **sans locomotive** : *unanchored, anchorless*

8 Contextes :

Anchor stores typically account for about 80 percent of the space in a power center, compared with less than 50 percent in most conventional strip centers. (Mason et Mayer 1990 : 657)

Le pouvoir d'attraction du centre commercial est basé [...] sur la réunion en un même lieu de magasins aux activités complémentaires et le plus souvent concurrentes et en outre sur la présence d'un ou de plusieurs grands établissements commerciaux fréquemment qualifiés de " locomotive " du centre [...]. (Vigny 1990 : 181)

9 Exemples :

Locomotives du centre commercial Potomac Mills (Virginie, É.-U.) : IKEA, The Sports Authority, etc.

Appendix B

List of lexical functions cited in the article

Lexical function	Description	Example
Anti	Antonym	**Anti**(anchor) = satellite store
Gener	Hyperonym	**Gener**(direct advertising) = advertising
Mult	A collection containing similar members	**Mult**(customer) = // clientele
Oper$_i$	support verb when the key word is the direct object	**Oper**$_1$(banner) = carry [ART ~]
Part	A functional part within a whole	**Part**(wireless POS terminal) = keyboard
Phase	A phase within a process	**Phase**(prospection) = canvassing
S$_I$	Typical noun for first actant (generally the agent)	S$_1$(distribution) = distributor
Sing	A member within a collection	**Sing**(product mix) = // product
Spec	Hyponym	**Spec**(mass merchandiser) = hypermarket
Syn$_\cap$	Synonym (one that has common and different semantic components	**Syn**$_\cap$(convenience good) = unsought good
V$_0$	Verbalization	**V**$_0$(counterfeiting) = counterfeit