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-16-

The Functional Lexematic Model: past, present and future.

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1. Introduction

The Functional Lexematic Model (FLM) was originally created by Leocadio Martín Mingorance (1947-1995), a linguist far ahead of his time. Many years before it was fashionable to do so, he foresaw the importance of the interface between syntax and semantics, with an emphasis on semantics. Indeed, the acknowledgement of the prominence of the lexicon and its structure in linguistic theory is a constant theme throughout his work. Some years before Levin's (1993) book on alternations, he was aware that verb semantics is the driving force behind syntax, rather than vice versa. Thus, one of the cornerstones of the FLM is the claim that the lexicon is the storage place for syntax, and that there is a mechanism that explains how the argument structure of a verb interacts with the information in meaning definitions. His vision of semantics and its important role in linguistics reflects his foresight and ability to predict the future direction of linguistic thought.

After his death, his papers were compiled and published (Martín Mingorance 1998). Nevertheless, his writings are only a pale reflection of the richness of his creativity and innovative thought. One reason for this was that a significant part of his legacy was oral and only disseminated among his closest followers, whom he delighted in instructing. While Leocadio Martín Mingorance was alive, the authors of this paper had the privilege of benefiting from his teaching, and after his death, we became the inheritors of his dreams. In that sense, it is hardly surprising that the only detailed description of Martín Mingorance's FLM is found in Faber and Mairal (1999), a book written in his memory. We would like to believe that this is the book that we would have written with him had he been alive.

Over the years, the FLM has evolved and has been applied in a wide range of research areas and for an even wider range of purposes. This chapter provides an overview of some of the applications of the FLM and explores how it has been used (and is currently being used) in different linguistic fields. It also explores and discusses the valuable insights that it has provided for fields such as Translation, Terminology, and Lexicography.

The rest of this chapter is organized as follows. Section 2 gives a brief overview of the FLM. Section 3 discusses the evolution of the FLM and how it is currently being applied to linguistic theory within the framework of Role and Reference Grammar (Van Valin 1993) and Construction Grammar (Goldberg 2005). Section 4 describes the impact of the FLM on specialized language and Terminology, more specifically, as applied to the specialized translation process and to the elaboration and design of terminology knowledge bases. Section 5 summarizes the conclusions that can be derived from this chapter.

2. The Functional Lexematic Model of Martín Mingorance

The Functional Lexematic Model (FLM) was initially conceived as a way to integrate Dik's (1978a) Functional Grammar (FG) and Coseriu's (1977, 1978) Lexematic Theory. Its main objectives were: (i) the elaboration of the semantic architecture of the lexicon of a language; and (ii) the representation of knowledge based on the linguistic coding of dictionary entries. Originally, its purpose was to develop the FG lexicon component by structuring it in lexical domains, following the principles of definitional analysis underlying Dik's (1978b) Stepwise Lexical Decomposition. The resulting lexical organization was derived from the convergence of both paradigmatic and syntagmatic information as a reflection of the interface between syntax and semantics (Faber and Mairal 1999).

As a result, the FLM assigns a prominent role to the lexicon and argues that the lexicon of a language should be conceived as a grammar that accounts for the full potential of a speaker's lexical competence. Within such a lexicon, the word is the central unit of description and its entry includes the syntactic, morphological, semantic, and pragmatic properties that it embodies. The FLM thus set out to construct a formalized grammatical lexicon, organized onomasiologically into semantic hierarchies based on shared meaning components. This involves the elaboration of an inventory of lexical domains, a system of definitions and definitional structure, and the specification of superordinate lexical units through the factorization of meaning components extracted from dictionaries as texts that embody our shared knowledge of words.

It was thus necessary to come to grips with meaning on both the micro and macrostructural level. Microstructurally, the focus was on the role that meaning definitions play in the development of an interface between syntax and semantics. Macrostructurally, lexemes had to be situated within the larger context of their lexical domain, and their relations with lexemes in other areas of meaning had to be specified. This means that within the FLM, lexemes are not conceived as a frozen list, but rather as dynamic representations within a conceptual network.

Meaning is thus an internal knowledge presentation. In this sense, language is a mirror of the mind in the sense of Langacker (1987), and lexical structure is a means of ascertaining and exploring the organization of concepts. Lexical meaning is in itself a cognitive model in which part of our knowledge of the world is symbolized by a linguistic expression. In addition, lexical relations at different levels of the lexicon hint at a map of conceptual relations.

As shall be seen in the following sections, the organization of the lexicon in a set of coherent lexical classes is a methodological position, which has since been endorsed in later work within lexical semantics, given that the meaning of a predicate is crucial for the prediction of its syntactic behavior.

3. Application to Linguistic Theory

One of the leading methodological claims of the FLM is that meaning construction lies at the crossroads of grammar, communication, and cognition. As a matter of fact, it comes as no surprise that the FLM defines itself as a functional and a cognitive model of language and maintains that meaning construction is a complex process that involves different linguistic and non-linguistic competences.

With this in mind, Ruiz de Mendoza and Mairal developed the Lexical Constructional Model (LCM), a broad meaning-construction model of language that provides meaning descriptions at four levels of analysis: (i) argument structure (level 1); (ii) pragmatic implication (level 2); (iii) illocution (level 3); (iv) and discourse (level 4). Two cognitive operations, *conceptual integration* and *cued inferencing*,

operate both within and across these four levels of description. These operations are in turn constrained by a set of principles (cf. Mairal and Ruiz de Mendoza, 2008; Ruiz de Mendoza and Mairal, 2008; Ruiz de Mendoza and Galera, 2014, etc.).

There are four methodological issues that characterize the FLM. The first is the capacity to integrate insights from different cognitive and functional approaches to language with the aim of providing answers to meaning construction. In this regard, both the FLM and the LCM have developed their own sets of postulates and analytical tools when necessary. Their dynamism is reflected in their capacity to adapt and incorporate research findings from other linguistic frameworks as well as from related disciplines (anthropology, psychology, sociology, etc.). In particular, the FLM has succeeded in integrating Dik's Functional Grammar and Coseriu's Lexematics and, in its most recent development, some of the elements of schema theory in its cognitivist version (cf. Lakoff 1987). Similarly, the LCM combines insights from lexical (or projectionist) and constructionist approaches to language.

The second methodological issue is the conception of language in general, and the lexicon in particular, as a repository of coded and non-coded (i.e. inferred) meaning representations. Whereas the FLM provides the analytical tools to explore the non-propositional dimension of meaning as represented in the format of a lexical entry (i.e. the pragmatic layer of the lexicon and culturally-loaded words), the LCM, with a similar focus on the inferential view of language, goes even further and features a Level 2 or *implicational module* that accounts for aspects of linguistic communication that have traditionally been handled in terms of situational implicature. Moreover, there is a Level 3 or *illocutionary module* dealing with traditional illocutionary force. Finally, a Level 4 or *discourse module* addresses discourse aspects of the LCM, with particular emphasis on cohesion and coherence (cf. Ruiz de Mendoza and Mairal 2008). Each level is either subsumed into a higher-level constructional configuration or acts as a cue for the activation of relevant conceptual structure that yields an implicit meaning derivation.

The third issue is the premise that meaning construction, whether coded or inferred, is based on cognitive modeling, i.e. creating conceptual representations that capture aspects of how we construe the world. Nonetheless, this is an endeavor that was never pursued in the

FLM although Martín Mingorance explicitly favored Lakoff's notion of schemas as repositories of information of the set of syntactic, semantic and pragmatic regularities that occur in a lexical subdomain. The LCM, in contrast, has developed this aspect in considerable detail. First, the LCM explicitly ascribes a cognitive model type to each of its organizational levels. Ruiz de Mendoza and Galera (2014) provide a complex classification of cognitive model types, but, in essence, the main parameters are the situational versus the non-situational nature of cognitive models and their degree of genericity (i.e. their high or low level).

More specifically, Level 1 of the LCM is based on high-level, non-situational cognitive models (e.g. action, instrument, result). Level 2 exploits low-level situational cognitive models (e.g. going to the dentist, teaching a class, driving a car). Level 3 makes use of high-level situational models (usually corresponding to speech act categories, although there are still more powerful higher-level formulations, such as the Cost-Benefit Cognitive Model; cf. Ruiz de Mendoza and Baicchi 2007). Level 4 makes use of relations between high-level non-situational cognitive models (e.g. cause-effect, action-result, condition-consequence).

Finally, the fourth issue is the notion of lexical template, which is of paramount importance in the LCM. It is inspired in previous work in the FLM (Mairal and Faber, 2002, 2007, 2017). The notion of lexical template is originally a development of the logical structures postulated in Role and Reference Grammar (RRG) (cf. Van Valin and LaPolla, 1997; Van Valin, 2005; Van Valin and Mairal, 2014). One of the problems of the logical structures in RRG is that these representations capture only those aspects of the meaning of a word that are grammatically salient at the cost of foreshadowing semantic and pragmatic factors which, though not syntactically visible, are also part of the meaning of a word. As Van Valin (2005) aptly remarks, a theory of semantic decomposition for activity and state predicates is still needed.

Lexical templates are constructed on the basis of a universal semantic metalanguage which includes an inventory of primes obtained by the factorization of meaning definitions and by a catalogue of operators, which express the way semantic primes combine to express more specific hyponyms. As previously mentioned, factorization is one

of the most important operations in the FLM to arrive at the semantic hierarchy of each lexical domain and subdomain. In this sense, Mairal and Faber (2017) provide a historical review of the different proposals that range from the use of internal variables, lexical functions, qualia structure, *inter alia*, in an effort to link syntax to conceptual or semantic meaning. More recently, the LCM has opted for a more ontologically-oriented model of semantic representation that provides a rich conceptual framework for the formalization of meaning construction. It is based on the notion of *conceptual logical structure*, which is coherent within the premises of the FLM.

In sum, many core assumptions of the LCM benefit from insights generated within the FLM. First, in both models, lexical structure and lexical organization are of the utmost importance. Meaning is projected through syntax, which means that meaning representations need to be generated for this projection. This is achieved by the specification of variables in the internal composition of lexical items. Some of these variables are semantic since they capture world knowledge and pragmatic implications, whereas others are formal (e.g. predicational arguments). The two sets of variables are bound in the representation. Second, both models take into account how we think and reason about the world. The FLM incorporates knowledge schemas into its descriptions, while the LCM develops these schemas in greater detail by endowing cognitive model types with the ability to determine descriptive and explanatory organizational layers in meaning construction. Finally, both the FLM and the LCM are sensitive to the distinction between coded and inferred meaning, although the LCM has been able to provide a full-fledged theory of inferencing, based on linguistic cues and the principled activation and exploitation of cognitive models (cf. Ruiz de Mendoza and Galera 2014).

3.1. Computational Linguistics

One of the main objectives of Leocadio Martín Mingorance was the transformation of the FLM into a computational framework. In fact, he showed great interest in Dik's incipient computational project written in Prolog and in the development of a functional logic that could imitate human reasoning.

In the last few years, FunGramKB, a "user-friendly online environment for the semiautomatic construction of a multipurpose lexico-conceptual knowledge base for NLP systems" (Mairal and Periñán, 2009: 219) has been developed (see www.fungramkb.com and the works cited therein). Technical details aside, the ontology, which is one of the modules of the conceptual level, provides a hierarchical catalogue of conceptual units. Concepts are thus provided with semantic properties in the form of 'Thematic Frames' and 'Meaning Postulates', two descriptive notions largely inspired in the FLM and Dik's Functional Grammar (1978a, b).

The description of each concept in the ontology consists of a thematic frame specification of event participants and a meaning postulate, which specifies an event and a number of obligatory and optional arguments. Meaning postulates are defined by means of metaconcepts, basic concepts, and terminal concepts, which are linked through inheritance relations in a stepwise conceptual fashion. The machine-readable metalanguage that supports this description is called COREL (*Conceptual Representation Language*). In much the same way as the FLM provided a hierarchical semantic network for the lexicon, FunGramKB's ontology provides a hierarchical arrangement of the conceptual units that lexical entries in each language are linked to. Interestingly, the procedures used to arrive at these hierarchies are very much the same. For example, the conceptual unit, +CONTRACT, is linked to lexical entries in Spanish (*contrato*), English (*contract*), Italian (*contratto*), and German (*Auftrag*). It is part of the following ontological hierarchy:

Homenaje a Rafael Monroy Casas

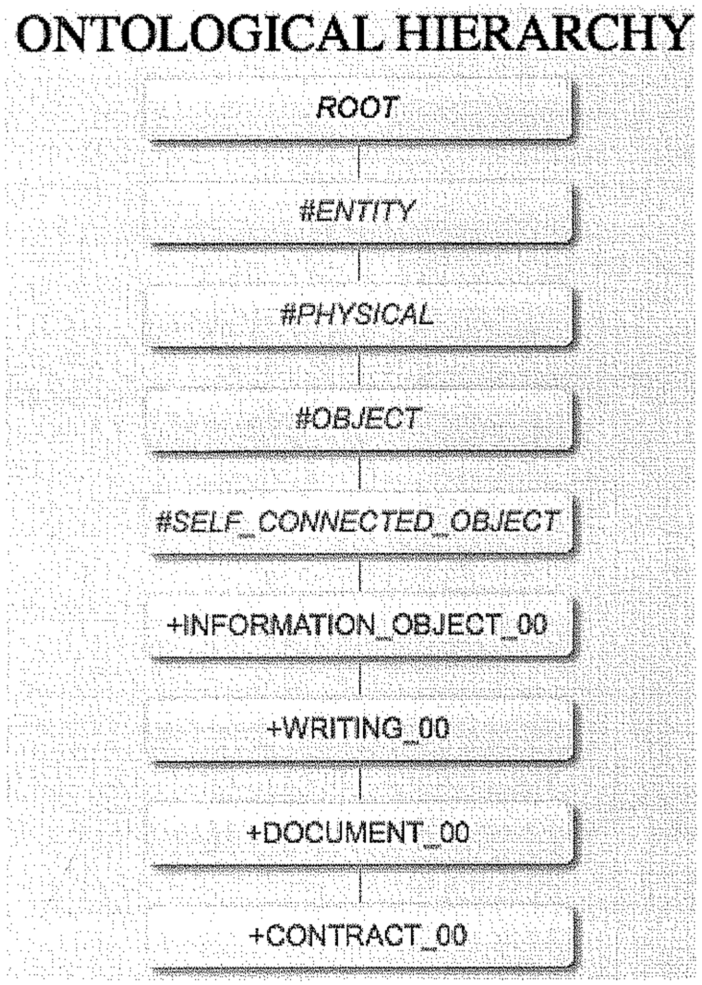


Figure 1: FunGramKB Ontological Hierarchy for *+CONTRACT-00*

+CONTRACT_00 is a basic concept, which is a member of the meta-conceptual category of #PHYSICAL_OBJECT and more specifically, that of #SELF-CONNECTED-OBJECT. Its conceptual path is +INFORMATION_OBJECT_00→ +WRITING_00→ +DOCUMENT_00. A contract is a type of information object, which is informative because of the writing in it, and which has the form of a document.

As a noun, *contract* has a relational structure. As a legal document that itemizes a transaction between a buyer and a seller, *contract* indirectly refers to a complex knowledge configuration, which speakers must access in order to understand the term. This information should be included in the meaning postulate of the conceptual entry. Accordingly, the conceptual entry for +CONTRACT_00 is composed of a meaning postulate with two main events, which state what type of entity a contract is (e1) and (e2) and the context in which it is produced (e3).

(1)
+(e1: +BE_00 (x1: +CONTRACT_00)Theme (x2: +DOCUMENT_00)Referent)
*(e2: +BE_01 (x1)Theme (x3: +LEGAL_00)Attribute)
*(e3: +AGREE_00 (x4: +HUMAN_00 ^ +COMPANY_00)Theme (x5)Referent (x6: +HUMAN_00 ^ +COMPANY_00)Goal (f1: x1)Means)

As reflected in (1), the lexical entry for *contract* activates knowledge that is linked to a given sociocultural context: a binding agreement between two or more persons especially one enforceable by law. Although this type of agreement can differ from one legal system or sociocultural context to another, generally speaking, the formalization of a contract involves an offer, acceptance, consideration, and mutual intent to be bound. Although contracts can be oral or written, written contracts are preferred in most legal systems. Needless to say, this document generally has a very specific structure, which constrains the information to be included in each of its clauses.

3.2. Lexicology

In the area of lexicology, the FLM has served as the basis for the development of the Minimal Definitions Project (*Proyecto Definiciones Mínimas*) as presented in Bosque and Mairal (2012, 2013). The primary aim of this project is to convert the FLM into a transcategorial model.

As previously mentioned, the FLM categorizes verbs in basic semantic classes. Each verb is thus characterized by an ordered set of semantic features that progressively reduce its extension and broaden its intension, always within the context of the other verbs in the same semantic class. Accordingly, the Minimal Definitions Project presents simplified descriptions of lexical items, composed of their most essential characteristics. These descriptions are called *definiciones mínimas* [minimal definitions].

This project is only one of many that is based on the necessity to conceptually associate lexical items and prioritize this type of organization over alphabetical order (though the two are not incompatible). As described in Bosque and Mairal (2013), important aspects include the following:

- Lexical entries are generally organized alphabetically in conventional dictionaries or conceptually in thesauruses, thematic dictionaries, ideological dictionaries, etc. Nevertheless, when *definienda* are organized conceptually in terms of the *definiens* or the words used to define them, this permits a large number of semantic connections between lexical items.
- The scope of the FLM can also be widened to make it applicable to other grammatical categories. This new transcategorial scope would mean that it could also be used to structure and define nouns, adjectives, and adverbs.
- The semantic clustering of definitions is a resource that can be used to regulate conceptual complexity. Words are structured in semantic layers so that the innermost layers inherit information from the outermost layers. This shows the progressively greater complexity of the defined terms, always based on a primitive that is not defined.

Here is a partial representation of the lexical entry for the Spanish adverb *"arriba"* hierarchically arranged in different notional layers (see Bosque and Mairal (2013) for the full representation of the complete hierarchy):

(2)
ARRIBA. Adv.

[1] SITUADO ARRIBA	[1a] **superior:** *la planta <u>superior</u>, el labio <u>superior</u>, la cavidad <u>superior</u>.*
	[1b] **susano** [antiguo]: «*...el ojo o nariz o el labro susano*» (Anónimo, *Libro de Alexandre*, CORDE).
	[1c] **susero** [antiguo]: «*...con nervios que se faz dentro en el parpado <u>susero</u>*» (Anónimo, *Tratado de patología*, a 1500, CORDE).

[2] DICHO ARRIBA	[2a] **susodicho**: «*la susodicha María Coral abandonó la compañía de los dos forzudos en Barcelona, quedándose aquélla mientras partían éstos*» (E. Mendoza, *La verdad sobre el caso Savolta*, CREA).		
[3] IR HACIA ARRIBA (HASTA UN LUGAR)	[3a] **subir** <subir, subir a él, subir hasta él>: *El humo sube; Los precios han vuelto a subir; Sube a mi despacho cuando puedas; El funicular ya no sube hasta el parque; El humo de las hogueras sube al cielo.*		
		[4] ACCIÓN DE SUBIR	[4a] **subida:** *La subida del tren al cerro; la fuerte subida de las temperaturas.*
			[4b] **suba** [dicho de precios, costes, etc.], [en el Río de la Plata]: *La suba de los alquileres.*

(*the lexical entry continues*)

Relational lexical descriptions such as those proposed in the FLM are interesting from both a lexicological and lexicographic point of view. It is a fact that very few Spanish lexical resources include information regarding semantic relations in their lexical entries. Exceptions are certain ideological dictionaries, collocation dictionaries, and dictionaries of synonyms and antonyms.

4. Application to Terminology and specialized language

The basic premises of the FLM have also been usefully applied to specialized language and Terminology. They have even provided the foundations for Frame-based Terminology, a new approach to specialized language, which along with the Sociocognitive Theory of Terminology (Temmerman 2000) represents the cognitive shift experienced in specialized language in recent years (Faber 2009).

4.1. Terminology theory

Frame-based Terminology (Faber, Márquez Linares, and Vega Expósito 2005; Faber *et al.* 2006: Faber *et al.* 2007, Faber 2012) is a derivation of the FLM (Martín Mingorance 1984, 1989, 1995; Marín Rubiales 1998; Faber and Mairal Usón 1999) and Frame Semantics (Fillmore 1982, 2006; Fillmore and Atkins 1998), which has been applied to specialized lexicography and terminography. In Frame-based Terminology, the premises of the FLM are used to codify and analyze

specialized language corpus data for the representation of conceptual and collocational relations.

The resulting organization of the specialized lexicon is partially based on the distinction between syntagmatic and paradigmatic relations, and the complementary principles of combination and selection (Saussure [1916] 1990; Lyons 1977: 241). This distinction is relevant because it underlies conceptual organization, independently of the linguistic system (Nelson 1985: 179). The paradigmatic axis codifies the configuration of concepts in the selection axis, conceptually organizing the specialized lexicon in a hierarchy of domains and subdomains. In a parallel way, it is a determining factor in the syntagmatic axis, which codifies a term's combinatorial potential. The convergence of these two axes is the basis of conceptual structure in the specialized lexicon.

This relational approach is relevant for Terminology because it focuses on meaning, and more concretely, on conceptual domains. It is based on the premise that there are a series of properties shared by all of the member concepts within a domain, and other properties that differentiate them. Semantic memory is represented as a complex network in which each node is a concept, and in which the concepts are interconnected by a wide range of different types of relations within a frame- like structure.

As such, Frame-based Terminology consists of the following set of micro-theories: (i) a semantic micro-theory; (ii) a syntactic micro-theory and (iii) a pragmatic micro-theory (Faber 2015). Each micro-theory is related to the information encoded in term entries, the relations between specialized knowledge units, and the concepts that they designate. The semantic micro-theory involves an internal and external representation. The internal representation consists of a definition template used to structure the meaning components and semantic relations in the description of each specialized knowledge unit. The external representation is a domain-specific ontology whose top-level concepts are OBJECT, EVENT, ATTRIBUTE, and RELATION. The ontology is based on the conceptual representations of physical objects and processes (e.g. ALLUVIAL FAN, GROYNE, EROSION,WEATHERING, etc.). The syntactic micro-theory is event-based and takes the form of predicate-argument structures. The nature of an event depends on the predicates that activate the relationships between entities. Finally, the pragmatic micro-theory is a theory of contexts, which can be linguistic or extralinguistic. Linguistic contexts (spans of +5 items before and after a term) are crucial in the design of a terminological knowledge base for term disambiguation, definition formulation, linguistic usage, conceptual modeling, and term extraction. Such contextual information shows how terms are activated and used in specialized texts in the form of collocations and collocational patterns (Faber *et al.* 2016).

4.2. Specialized translation

The FLM has also been applied to specialized language translation with a view to proposing a meta-language in the form of conceptual propositions that can act as an *interlingua* to facilitate correspondences between languages. Lexical units, whether general or specialized, are conceived as translations of our interpretation of perceptual data because they and their combinatorial possibilities are the external representations of our model of the world. Such a language of internal meaning representation explains translation since to translate a text from one language to another, there must be a conceptual representation shared by both. In scientific and technical texts, specialized knowledge units activate domain-specific semantic frames that are in consonance with the domain as well as with the user's background knowledge. These frames are the context in which Frame-based Terminology, as derived from the FLM, specifies the semantic, syntactic and pragmatic behavior of specialized language units.

Specialized translation differs from general translation in that it involves the translation of texts directed to a group of text receivers, who are usually familiar with the specialized subject field, terminology, text templates, and communication patterns used in a specialized domain. In this type of translation, it is generally thought that the major difficulty lies in establishing terminological correspondences between languages since syntactic patterns in scientific and technical texts often tend to be simpler and less complex than in general language. However, the situation is not so straightforward since terms cannot be understood in isolation, and text decoders must be able to process terms in local as well as global contexts (Faber and León-Araúz 2015, 2016).

The specialized translator has to define the domains/subdomains activated in the text. As is well known, terms designate concepts.

Concepts are organized in a given domain in structured network or conceptual system, which reflects the perceived reality of a specialized discipline or area of professional activity. Correspondingly, each conceptual system is a structure with various subclasses of concepts, only some of which appear in the text.

Moreover, terms generally take the form of phrasemes and complex nominal forms that have their own syntax. The collocations in which they participate depend on the specialized knowledge domain and text type. Knowledge of two languages and their respective grammars is thus not sufficient unless translators also know how to couple this knowledge with conceptual and intertextual knowledge.

As previously mentioned, the FLM provides a basis for translation correspondence between languages because it establishes a basis for interlinguistic comparison in the form of a basic set of predicates, which are the generic terms of semantic classes lexicalized in all languages. In both general and specialized translation, text-driven conceptual representation is usually in the form of some type of predicate-argument structure in which semantic predicates of the source text activate types of arguments that have semantic roles.

Each predicate has an argument structure, which specifies the predetermined number of arguments that the predicate can have. These arguments are essentially the participants that are minimally required for the activity or state described by the predicate. In specialized texts, the arguments are filled by specialized knowledge units, which constrain the meaning of the general language predicate (Faber and León-Araúz 2016). Such representations can and should include the decomposition of the predicate and the specification of the semantic characteristics of the arguments (Mairal Usón and Faber 2007). The sequence and interrelation of these predicate-argument structures or propositions in a text are what makes it coherent.

Consequently, it could be said that conceptual representation is the convergence point for translation and terminological work, and thus should be a key factor in translation and in the elaboration of terminological resources that aid knowledge acquisition.

4.3. Specialized knowledge representation and resource design

Without a doubt, one of the major difficulties facing translators as well as other text users interested in specialized knowledge acquisition is the lack of useful lexical and terminological resources specifically conceived for text decoding and encoding. Rather than a database where information is collected and stored, what is really needed is a knowledge base where these data are related and organized in the form of templates or knowledge propositions, similar to those proposed by the FLM (Faber and Mairal 1997b, 1998b, 1999). In other words, the resource should be based on conceptual representation. Surprisingly, despite the acknowledged importance of conceptual representation in terminological work, there is a lack of conceptually organized translation resources that codify knowledge rather than merely store data (Faber *et al.* 2006, Faber 2011).

In order to create such a resource, FLM principles were applied to the specialized lexicon within the domain of environmental science. Since the FLM has mostly focused on predicates, it was necessary to expand it and apply it to other grammatical categories, such as noun phrases, which have a high prevalence in specialized language.

The result is EcoLexicon (ecolexicon.ugr.es), which is the practical application of Frame-based Terminology and thus, of the FLM to the specialized lexicon. EcoLexicon is a multilingual terminological knowledge base on the environment (Faber *et al.* 2014, 2016). The knowledge base was initially implemented in Spanish, English, and German. Currently, four more languages are being added: Modern Greek, Russian, French, and Dutch. So far it has 3601 concepts and 20212 terms. It targets different user groups, such as translators, technical writers, environmental experts, etc., who wish to expand their knowledge of the environment for the purpose of text comprehension and/or generation.

In EcoLexicon, environmental concepts are codified in terms of natural language definitions that are visually represented as a network of both hierarchical and non- hierarchical semantic relations extracted from a multilingual corpus of specialized texts (Faber, Mairal-Usón, and Magaña 2011). The ontology underlying this environmental knowledge base is primarily based on representations of physical objects and processes (e.g. *alluvial fan, erosion, weathering,* etc.). This

basic set of concepts act as a 'scaffold', and their natural language descriptions provide the semantic foundation for data querying, integration and inferencing (Faber and San Martín 2011).

This clear application of the FLM to specialized language is in consonance with cognitive semantics (Talmy 2000), which claims that lexical meaning is a manifestation of conceptual structure. The meaning of words thus does not depend on the world itself, but rather on our categorization of the world (Evans, Bergen, and Zinken 2007). This is evident in the lexical domains of *existence* (Faber and Mairal 1997a) and *feeling* (Faber and Mairal 1998b), and is also reflected in the domain of solid geological objects such as *igneous rock* (Gil-Berrozpe and Faber 2016), where different classifications co-exist, depending on perspective.

In EcoLexicon, great care has been taken to create an internally coherent information system with sufficient dynamism and flexibility to represent the multidisciplinary field of the environment and facilitate information retrieval by the end users (Faber 2011). At the macrostructural level, the information is organized in a prototypical domain event and stored in a relational database as well as a domain ontology. A closed inventory of conceptual relations makes the microstructure of the resource consistent with its macrostructure.

A set of definitional templates based on the prototypical domain event and these conceptual relations constitute a definitional grammar for the creation of the meaning definitions of specialized concepts. In this way, definitions have a uniform structure that enhances the information in the conceptual system, and directly refer to and evoke the underlying event structure of the domain. These templates can be considered a conceptual grammar that reflects category membership throughout the environmental domain, and thus ensures a high degree of systematization at the microstructural level. The existence of conceptual templates in the brain was validated by fMRI experiments performed with experts and novices. Preliminary results indicate that these templates are activated in the brains of experts (though not of novices) to identify specialized knowledge objects (Faber *et al.* 2014).

Figure 2 shows the Ecolexicon entry and representation of *erosion* (León-Araúz, Reimerink, and Faber 2013).

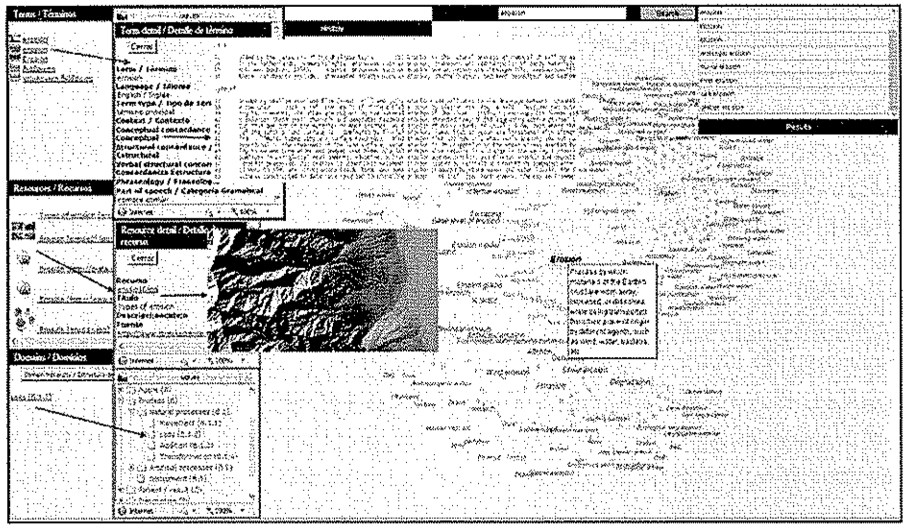


Figure 2: Screen capture for *erosion* in Ecolexicon

From a visual perspective, concepts appear in conceptual networks that link them to other related concepts by means of a closed inventory of semantic relations, especially conceived for the environmental domain. Access is also provided to the meaning definition, correspondences in other languages, corpus concordances, and visual images.

Visual images are an important part of a multimodal knowledge, especially when they are included in such a way as to complement the information provided in definitions. As previously mentioned, Ecolexicon definitions are based on category templates. However, the images included in each entry are also linked to the semantic relations activated in each template. For example, the *erosion* template includes the four basic relations for all natural processes: *is_a*, *has_agent*, *affects* and *has_result*. It also has an additional relation *has_phase* because it can be divided into a sequence of steps.

More specifically, WATER EROSION, as a specific type of EROSION has a *has_agent* relation to WATER. However, given that the *has_patient* relation is the Earth's surface, which includes a wide range of entities, more than one image needs to be included to reflect this relation. In regard to the *has_phase* relation, three images are required

to show the three phases of WATER EROSION, as reflected in their result (see Table 1).

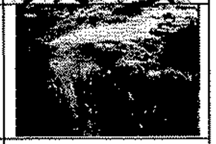
Water erosion		
type_of	erosion	
has_agent	weathering [river, stream, rain, wave, current, etc.]	
affects	Earth's surface [beach, mountain, soil, etc.]	
has_result	sheet, rill, gully	
	cliff, beach	
has_phase	weathering	
	transport	
	deposition	

Table 1: *Water erosion* template (León-Araúz, Reimerink and Faber 2013)

EcoLexicon was created over ten years ago and has since been expanded and enhanced, thanks to four successive research projects funded by the Spanish government. It has proven itself to be a useful resource for purposes of text decoding and encoding. In studies focusing on translators as a user group, its content and structure were tested with extremely positive results (Giacomine 2014; García-Aragón *et al.* 2014).

Moreover, in the past decade, EcoLexicon has evolved and made significant advances in the representation of environmental knowledge. Its modules and the information that they contain have been expanded. Users now have access to contextualized networks, a specialized corpus on the environment, and to other web-related options such as Google images and Wolfram Alpha.

Conclusion

The FLM acknowledges the central role of the lexicon in linguistic theory, and is thus a good example of the panlexicalist orientation of linguistic models during the 1980s. The FLM provides the analytical tools to organize the lexicon into coherent semantic classes and conceives the lexicon as a vast hierarchical semantic network. Furthermore, each lexical class is represented as a mini core lexical grammar where semantic, syntactic and pragmatic regularities and patterns converge.

As is well known, the strength of any linguistic model lies in its explanatory adequacy. In this paper, we have shown that the FLM has been present to a greater or lesser degree in the genesis of very competitive linguistic proposals regarding linguistic theory, computational linguistics, lexicology, terminology, and translation. These proposals are based on the functional and cognitive premises outlined in the FLM, and lay the groundwork for theories that provide stimulating answers to the complex linguistic problem of meaning construction.

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-17-

De Amicitia.

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