CHAPTER 7

Specialized knowledge dynamics

From cognition to culture-bound terminology

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This chapter examines the multidimensional representation of specialized concepts and concept systems within the context of new theories of simulated cognition and culture-bound terminology. According to the premises of Frame-based Terminology (Faber et al. 2005; Faber et al. 2006; Faber et al. 2007), conceptualization is regarded as a dynamic process that is modulated by human perception. In addition conceptual categories previously thought to be universal (e.g. natural geographic entities) are also shown to be constrained by cultural perceptions. Contextual information related to situational simulation and culture is thus used to configure specialized domains on the basis of definitional templates and situated representations for specialized knowledge concepts.

7.1 Introduction

Dynamicity is the condition of being in motion, and thus, is characterized by continuous change, activity, or progress. In recent years, a number of publications on Terminology have focused on the dynamicity of specialized knowledge understanding. This is only natural since dynamicity is acknowledged to be an important part of any kind of knowledge representation system or knowledge acquisition scenario. However, an in-depth study is needed of the dynamicity of conceptualization, and how the nature of human perception and cultural cognition influences the representation of concept systems and terms in specialized knowledge contexts.

As is well known, a major focus in Terminology and specialized communication has always been conceptual organization. In fact, a great deal has been written on the topic (Budin 1994; Puuronen 1995; Meyer, Eck, and Skuce 1997; Pozzi 1999; Pilke 2001; Feliu 2004; Faber et al. 2007; León-Araúz 2009, *inter alia*). Given the fact that terms are specialized knowledge units that designate our conceptualization of objects, qualities, and processes in a specialized domain, any theory of Terminology should aspire to neurological, psychological, and cultural adequacy. In this sense, knowledge of conceptualization processes as well as the organization of semantic information in the brain should underlie any theoretical assumptions concerning the retrieval and acquisition of specialized knowledge concepts as well as the design of specialized knowledge resources. Furthermore, since categorization itself is a dynamic context-dependent process, the representation and acquisition of specialized knowledge should also focus on contextual variation (León-Araúz, Reimerink, and Aragón 2013), which includes external factors (both situational and cultural) as well as internal cognitive factors, all of which can influence one another (House 2006: 342).

Nevertheless, Terminology has not as yet seriously taken on board recent research advances in cognition and cognitive neuroscience, which point to the inadequacy of standard theories of cognition (Gallese and Lakoff 2005). These standard theories of cognition are based on abstract, amodal representations of entities, events, and processes that do not take into account the human and contextual factor of processors, their focus of attention, and cultural knowledge. Nonetheless, these conventional theories of cognition are the same theories upon which mainstream conceptual representations in Terminology are currently based. This is reflected in Terminology manuals as well as in the design of specialized knowledge resources.

For example, most of these manuals (e.g. Cabré 1999; Pavel and Nolet 2001) mention the fact that part of terminology work is the elaboration of a graphical representation of a concept system of the specialized field with the help of an expert and the use of specialized thesauri. However, very little is said about how this representation is created, and the premises upon which it is based. Various authors have expressed discontent with the current shape of concept systems (e.g. Nuopponen 1994; Cabré 2000; Temmerman 2000). Rogers (2004: 221) criticizes the fact that each node in the representation of a concept system is conventionally labeled by a decontextualized lexeme despite the fact that knowledge, as represented in texts, is conceptually dynamic and linguistically varied.

Quite understandably, cognitive and cultural dynamicity is difficult to capture and portray in a static representation. Perhaps for this reason, the explicit representation of conceptual organization does have an important role in the elaboration of terminological resources. Most resources that do offer such information base their representations exclusively on the *is_a* or *type_of* conceptual relation in the form of tree or bracket diagrams (e.g. Figure 1).

However, even this type of organization is a fairly rare occurrence (Faber et al. 2006).

Even when conceptual representations are included, they do not correspond to current theoretical accounts of how conceptualization takes place in the mind since mental representations are much richer and more flexible. Part of this

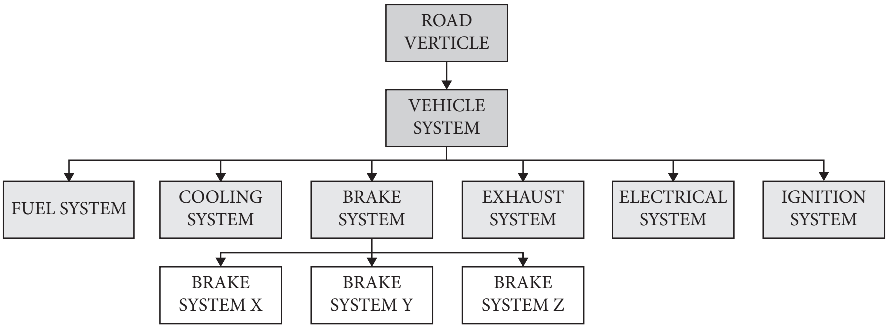

Figure 1. Example of standard conceptual hierarchy

perceived richness stems from the inherent dynamicity of conceptual processing and conceptualization, which involves change over time (Langacker 2001) and change across cultures.

Because of their dynamic nature, grounded or situated cognition theories are of vital interest for the representation of specialized knowledge. The question is how an awareness of the nature of mental processes can be applied to and incorporated in the terminographic representation of specialized knowledge concepts.

7.2 New theories of cognition

Recent research in cognitive psychology and neuroscience highlights the dynamic nature of categorization, concept storage and retrieval, and cognitive processing (Louwerse and Jeuniaux 2010; Aziz-Zadeh and Damasio, A. 2008; Patterson, Nestor and Rogers 2007; Gallese and Lakoff 2005). This work underlines the inadequacy of standard theories of cognition that claim that knowledge resides in a semantic memory system separate from the brain's modal systems for perception, action, and introspection. According to standard theories, representations in modal systems are not greatly influenced by the perceiver and the context of perception, and are transduced into amodal symbols, which are not specific of the mode of perception. These symbols represent knowledge about experience in semantic memory (Barsalou 2008: 618; Mahon and Caramazza 2008: 59).

However, there is an increasing consensus in favor of a more dynamic view of cognitive processing or situated cognition, which reflects the assumption that cognition is typically grounded in multiple ways. These include simulations, situated action, and even bodily states. The embodied or grounded cognition hypothesis equates understanding with sensory and motor simulation. This hypothesis claims that interactions between sensorimotor systems and the physical world underlie cognition. When we encounter a physical object, our senses represent it during perception and action. Processing the object involves partially capturing property information on these modalities so that this information can later be reactivated (Damasio, A. and Damasio, H. 1994).

For example, to represent the concept, PEACH, neural systems for vision, action, touch, taste, and emotion partially reenact the perceiver's experience of a peach. These reenactments or simulations are not the same thing as mental imagery, which is consciously evoked in working memory. Unlike mental imagery, these simulations seem to be relatively automatic processes that lie outside of our awareness (Simmons et al. 2005: 1602).

To date, brain-imaging experiments have largely involved everyday objects such as cups, hammers, pencils, and food, which, when perceived, trigger simulations of potential actions. For example, the handle of a cup activates a grasping simulation (Tucker and Ellis 1998; 2001). Food activates brain areas related to gustatory processing as well as areas in the visual cortex representing object shape (Simmons et al. 2005). Neuroimaging research thus confirms that simulation is a key part of conceptual processing (Martin 2007).

Such reenactments not only occur in the presence of the object itself, but also in response to words and other symbols. It would thus appear that simulations have a central role in the representation of conceptual knowledge (Barsalou 2003; Martin 2007). For precisely this reason, they should be taken into account in Terminology. To our knowledge, few if any neuropsychological experiments of this type have ever been performed with specialized concepts, but there is no reason to suppose that the brain would work any differently.

For example, when reading about hockey, experts were found to produce motor simulations absent in novices (Holt and Beilock 2006). In all likelihood, the result would be the same if the object were a tide gauge, pluviometer, or anemometer. The expert's brain would show motor simulations in brain areas that would not be activated in the case of non-experts to whom the object was unfamiliar. The information regarding simulated interaction is thus a vital part of conceptual meaning.

The nature of such simulations is componential rather than holistic. In other words, they are not continuous streamed video recordings, but rather contain many small elements of perception, which arise from all modalities of experience (Simmons et al. 2005). The way that objects are represented in our brain seems to suggest that current methods and ways of elaborating specialized knowledge representations should be modified in order to take this information into account.

Cognition is culture-dependent as well, since our modalities of experience and our perception cannot be separated from the environment where we live and our previously stored experiences. The study of cultural phenomena by neuroscience has focused on the influence of both cognition and culture on categorization, and have shown that neural plasticity may partly result from cultural experience (Reynolds Losin, Dapretto and Iacoboni 2010; Raizada et al. 2008). This means that culture can actually shape the brain.

7.3 The dynamics of Terminology

Terminological dynamicity has been explored from a wide variety of perspectives. For example, our knowledge of specialized fields evolves, and the terms used to describe the concepts in them also change (Bowker and Pearson 2002: 48; Kristiansens, in this volume). Dynamicity is a property of term formation as explored in Kageura (2002), and underlies the idea of the emergence of terms. Dynamicity is also reflected in the historical evolution of term meaning within sociocultural context (e.g. *splicing*, Temmerman 1995; 2008). Moreover, the constant change in term meanings may require human intervention in the form of terminological control (Oeser and Budin 1995). However, what underlies all of these perspectives is the fact that conceptualization or concept formation itself is dynamic. This is the process through which we access and acquire knowledge.

In reference to dynamic conceptualization, Wright (2003) and Antia et al. (2005) refer to A. Damasio (1994) and the dynamic variability of his model of concept formation. Concepts take the form of fleeting perceptions, which are essentially instantaneous convergences of perceptual aspects that combine during a given window in time and space. The main conclusion seems to be that concepts stem from a series of iterative processing events, and are in constant flux in the brain.

However, the position that semantic memory arises from universal connectivity in the brain without a stable neural architecture is no longer tenable (Patterson, Nestor, and Rogers 2007: 976). It is true that current theoretical positions regarding semantic memory share the view that much of our semantic memory relates to perception and action. Nevertheless, in order to generalize across concepts of similar semantic significance, there must also be a single convergence zone or hub that supports the interactive activation of representations in all modalities for semantic categories (Patterson, Nestor, and Rogers 2007: 977).

Such theories have a range of possible applications in Terminology that are just beginning to be explored. First of all, situated conceptualizations underline the fact that concepts are not processed in isolation, but are typically situated in background situations and events (Barsalou 2003). This signifies that context is all-important in knowledge representation. At any given moment in the perception of the entity, people also perceive the space surrounding it, including the agents, objects, and events present in it (Barsalou 2009: 1283).

This can be directly applied to specialized knowledge modeling to ensure the comprehensiveness of terminological entries. In fact, it can act as a safeguard against omitting other closely related concepts in the same knowledge domain. For example, EROSION is the wearing away of the earth's surface, but whether conceptualized as a process or the result of a process, erosion cannot be conceived in isolation. It is induced by a natural force that acts as though it were a human agent (WIND, WATER, or ICE) and affects a geographic entity (the EARTH'S SURFACE) by causing something (SOLIDS) to move away. Moreover, any process takes place over a period of time, and can be divided into smaller segments. In this sense, EROSION can happen at a specific season of the year, and may take place in a certain direction.

Perception of EROSION can also be culture-bound since ice-produced erosion (and its related concepts) will be more salient or prototypical in language-cultures in Arctic regions. All of this context-modulated information should be available for potential activation when the user wishes to acquire knowledge about it.

Secondly, although dynamicity has been regarded primarily as an attribute of event and action concepts (Pilke 2001; Puuronen 1995, *inter alia*), as shall be seen, grounded or situated cognition means that object concepts are also dynamic since they are processed as part of a frame or dynamic context which highlights the type of action that they participate in. This, in turn, affects how concepts should be represented in order to facilitate knowledge acquisition and understanding.

Thirdly, research results in this area indicate that knowledge acquisition requires simulation of human interaction with objects, and this signifies that horizontal or non-hierarchical relations that define the goal, intended purpose, and result of the use of an object (e.g. *has_function*, *affects*, *has_result*, etc.) are just as important as vertical ones, such as *type_of* or *part_of*.

Therefore, the representation of objects is closely linked to that of processes, since objects cannot be understood without the simulation of the events in which they participate. However, culture-bound conceptualizations also have an important role. In knowledge representation, objects and their designations should reflect contextual variation across disciplines and cultures as well as the fuzzy category boundaries they establish.

Even though it might be thought that cultural knowledge does not play an important role in databases and systems that represent a specialized topic domain, this is not the case since any ontology reveals a rich diversity and specificity which includes a cultural component (Srinivasan, Pepe, and Rodriguez 2009). Both general and specialized concepts are often culture-bound. This is only natural since concepts are mental constructs, created in the minds of human beings who exist in their bodies as well as in specific geographic locations (e.g. categorization of WETLAND, Section 7.2.1)

In this sense, culture-bound terminology (Diki-Kidiri 2008 and in this volume) has recently emerged as a new approach towards specialized conceptualizations, which underlines that each community parcels reality in a different way. This generates culture-specific concepts and terms. Even term variation should not be regarded as a linguistic phenomenon isolated from conceptual and cultural representations since it is one of the manifestations of the dynamicity of categorization and expression of specialized knowledge (Fernández-Silva, Freixa, and Cabré in this volume).

According to Freixa (2002), certain term variants are not only formally different, but also semantically diverse, as they give a particular vision of the concept. For instance, the imaginary line between the core and the mantle of the earth may be called *Gutenberg's discontinuity* or *core-mantle boundary*. The first term highlights the person who named it and the second term, the two sections in which it is divided. The choice of these terms has significant cognitive consequences regarding the way receivers access the concept (Fernández-Silva, Freixa, and Cabré, in this volume). Thus, even though the analysis of term variants is often restricted to geographic or register differences, they can also serve as access routes to different conceptualizations of the same entity.

Multidimensionality has a strong influence not only on how concepts are classified, but also on how term variants emerge. These variants can stem from cultural differences. For instance, in Spanish there are two ways to designate the concept RUBBLE-MOUND BREAKWATER: *dique de escollera* [breakwater of rubble-mound] or *dique en talud* [breakwater in slope]. *Dique de escollera* would be the direct equivalent of the English term, because both of them focus on the material dimension (rubble-mound), whereas *dique en talud* focuses on the place where it is located (a slope). Since all rubble-mound breakwaters are built on a slope, two conceptualizations are possible, but only in Spanish do they emerge as lexicalized term variants. However, even though *rubble-mound* and *escollera* express the same dimension of BREAKWATERS, in Spanish, *dique en talud* is the most frequently used term. The study of terminological variation from a cross-linguistic perspective can thus yield interesting results on how different cultures and languages categorize specialized concepts.

7.4 Frame-based Terminology and dynamic knowledge representation

As previously mentioned, simulation represents the way we interact with an entity and how entities interact with each other. This means that no specialized knowledge concept can be activated in isolation, but rather as part of an event where perception, culture, and many other dynamic factors may trigger different conceptualizations. Accordingly, when this is applied to Terminology and specialized communication, this has the effect of making context or situation a crucial factor in knowledge representation. Our knowledge of a concept initially provides the context or event in which it becomes meaningful for us. A knowledge resource that facilitates knowledge acquisition should thus provide conceptual contexts or situations in which a concept is related to others in a dynamic structure that can streamline the action-environment interface. Rather than being decontextualized and stable, conceptual representations should be dynamically contextualized to support diverse courses of goal pursuit (Barsalou 2005: 628).

Frame-based Terminology (Faber et al. 2006; Faber et al. 2007; Faber 2012) uses a modified version of Fillmore's Frames (Fillmore 1982, 1985; Fillmore and Atkins 1992) coupled with premises from Cognitive Linguistics to configure specialized domains on the basis of definitional templates and situated representations for specialized knowledge concepts. Recent research in cognitive neuroscience also has implications for specialized domains. Not surprisingly, domains have also been found to exist in the brain in some form, as shown in the extensive body of research on category-specific semantic deficits (Humphreys and Forde 2001; Caramazza and Mahon 2003; Martin 2007; Mahon and Caramazza 2008, 2009, *inter alia*).

Although initially research did not provide conclusive evidence of the important role of categories, the domain-specific hypothesis (Caramazza and Shelton 1998) assumes that the first-order constraint on the organization of information within the conceptual system or the organization of conceptual knowledge in the brain is object domain. In this model, object, domain and sensory, motor, and emotional properties jointly constrain the organization of conceptual knowledge. In addition, object domain is a first-order constraint on the organization of information at both a conceptual level as well as at the level of modality-specific visual input representations (Mahon and Caramazza 2009: 34). Although Mahon and Caramazza (2009: 30) restrict basic domains to those with an evolutionary relevant history (e.g. living animate, living inanimate, conspecifics, and tools), their observation that domains are constrained by the nature of concept members has evident implications for Terminology.

One conclusion that can be derived from this hypothesis is the fact that not all categories are structured in the same way, and that organization is constrained in some significant way by the nature of the category itself. In Terminology, there are two different ways of conceiving specialized domains. Domains can either be viewed as conceptual categories (e.g. GEOGRAPHIC OBJECTS, MARITIME CONSTRUCTIONS, etc.) or as specialized knowledge fields (e.g. GEOLOGY, ENGINEERING, etc). Furthermore, category structure is not only affected by the setting in which referents are located or the way in which people relate to them. It is also directly affected by the immediate temporal, physical, and situational context of the members of a cultural community. This causes conceptual differences that are reflected in the terms and categories of specialized domains.

Since frames are generally defined as a network of concepts related in such a way that one concept evokes the entire system (Fillmore and Atkins 1992), Frame-based Terminology accounts for the representation of different levels of frames according to the different factors involved in the dynamicity of knowledge. The practical application of Frame-based Terminology is EcoLexicon (ecolexicon.ugr.es), a multilingual terminological knowledge base, which is the source of the examples in the following sections.

7.5 Domains as conceptual categories

Object concepts in EcoLexicon are represented dynamically as embedded in events. They are stored in semantic memory, a major division of declarative memory, which contains information regarding the meaning of objects and words. This is the part of our mind that terminologists are trying to model each time they try to make a concept map. How knowledge is modeled largely depends on how objects are defined, their focal properties, their perceived relations with other concepts, and how the user understands them.

As a result, when domains are conceptual categories, categories are constrained by the nature of category members that share properties. For example, the categories of specialized INSTRUMENT and GEOGRAPHIC OBJECT are quite different from each other. This entails the elaboration of a different category template for each with a minimum of information. Nevertheless, category representation is often complicated since not all ontological categories are represented in the same way. This can occur for different reasons that are related to the nature of the entity, the nature of human perception, and cultural context.

7.5.1 Instrument objects

One of the basic characteristics underlying the representation of objects is knowledge of whether they can be manipulated. In the case of man-made objects, another important property is their function. This would mean that an important part of the information in the representation of specialized engineering INSTRUMENTS would evidently involve their purpose, their operation, and the result obtained. Moreover, meronymy can also be activated since an instrument is generally composed of parts. Table 1 shows a definitional template for the INSTRUMENT category.

Table 1. INSTRUMENT category template

INSTRUMENT	
Type_of	Type of instrument
Has_parts	Parts of the instrument
Has_funtion	Function of the instrument
Has_agent	Agent that manipulates the instrument

For example, a RECORDING INSTRUMENT (MARIGRAPH, PLUVIOGRAPH, ANEMOGRAPH, etc.) is a subtype of INSTRUMENT. As a man-made object, a recording instrument has a function (i.e. RECORDING) as well as an object that is recorded (TIDES, RAIN, WIND). As a tool, it is operated by humans and thus activates a simulation frame in which much of the perceiver's knowledge of the artifact involves his/her ability to handle it and in some way to extract information from it. For instance, Figure 2 shows the representation of PLUVIOGRAPH in EcoLexicon.

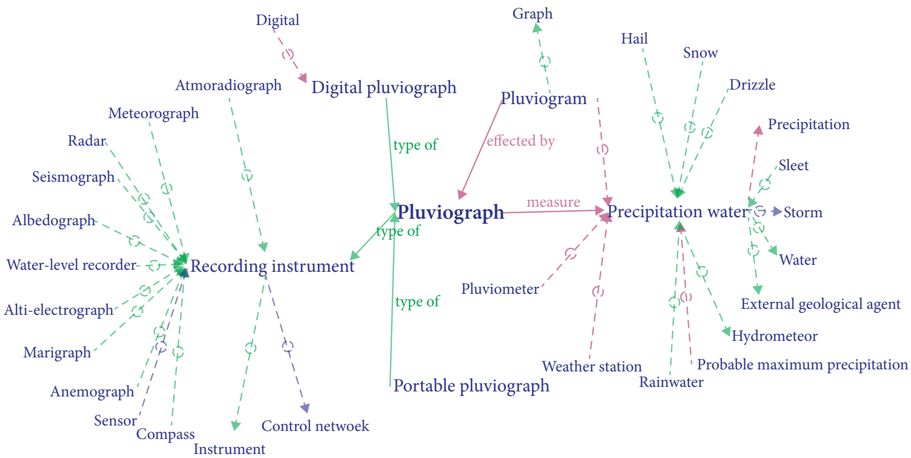

Figure 2. PLUVIOGRAPH semantic network

The representation of PLUVIOGRAPH, of course, includes *type_of* information. A PLUVIOGRAPH is a RECORDING INSTRUMENT, and has subtypes, such as DIGITAL PLUVIOGRAPH and PORTABLE PLUVIOGRAPH. However, it is also part of what might be called a recording event in which a human agent causes the machine to record and generate a representation of something (PRECIPITATION WATER). The recording instrument used in this event is a PLUVIOGRAPH, which produces (or effects) a PLUVIOGRAM. As can be observed in Figure 2, this process is reflected in the non-hierarchical relations REPRESENTS and EFFECTED_BY.

Evidently, in a globalized world, in which there is an effort to standardize meteorological instruments and information to facilitate communication, particularly in disaster scenarios, culture is not an important factor in the representation of this type of concept. However, culture would be a factor in the perception and interpretation of the data. For example, what would be regarded as a great deal of rain in a semi-desert region of southern Spain would be considered normal in northern England.

7.5.2 Geographic objects

The INSTRUMENT domain is in direct contrast to a domain such as GEOGRAPHIC OBJECTS, which is constrained by many other types of information, closely linked to the nature of the concepts. Geographic objects are presumably perceived and simulated in a different way, which naturally affects their conceptualization and representation.

Because geographic objects are immovable, they are not merely located in space but also bound to it. As such, they are closely linked to the culture and language of the people living in the area. As a result, they inherit from space many of its structural (mereological, topological, geometrical) properties (Smith and Mark 1998: 592). Most movable objects, such as living things or artifacts, rarely include *size*, *location* or *position* as category features. For instance, a PLUVIOGRAPH is a PLUVIOGRAPH, whether it is in water or on land or whether it is large or small. However, an identical piece of sandy ground can be a RIVERBANK or a BLUFF depending on what is located next to it (Mark, Smith and Tversky 1999). In the same way, a GROYNE is only a GROYNE when it is located on the sea and perpendicular to the shore, and the difference between a LAKE and a RESERVOIR exclusively depends on the elements (natural or artificial) which surround them.

Landscape, or more generally environment, can be regarded as a basic domain of human categorization since, like our bodies, it is a place that we inhabit (Burenhult and Levinson 2008: 136). It is the backdrop and scenario for human movement and is populated with landmarks for orientation and finding one's way within this space. This basic part of our existence gives rise to concepts that seem to comprise a semantic domain, although we must distinguish between natural geographic objects and artificial geographic objects.

7.5.2.1 *Natural geographic objects*

According to Smith and Mark (1999), the features of natural geographic objects are based on their location. They are often size- or scale-dependent and the products of delineation within a continuum in which other objects, including human agents, live and move. The existence of internal or external boundaries also implies the existence of parts. In fact, meronymy, rather than hyponymy, is a common way of categorizing geographic objects (Burenhult and Levinson 2008). As a result, the template in Table 2 shows that natural geographic objects in EcoLexicon are prototypically described by four different relations linked to the dimensions of *space*, *position*, *size* and *boundaries*.

Table 2. NATURAL GEOGRAPHIC OBJECT category template

NATURAL GEOGRAPHIC OBJECT	
type_of	Type of landform
has_part	Parts of the landform
located_at	Place where the landform is found
delimited_by	Boundaries of the landform
attribute_of	Shape (slope/elevation/rock exposure/soil type) of the landform

As shown in Figure 3, the representation of MARSHLAND ENVIRONMENT activates a different set of relations from instruments. As a geographic concept, MARSHLAND ENVIRONMENT is represented as being *delimited by* the SEA or a RIVER. LAGOONS, TIDAL FLATS and MARSHES are also geographic objects located in a MARSHLAND ENVIRONMENT. This is indicative of its size, which means that it can include a wide variety of geographic concepts. As a type of wetland, MARSHLAND is also culture-bound since, as shall be seen, different language-cultures have different perceptions of it, stemming from their immediate context.

Given that an object is represented within the event it participates in, other non-hierarchical relations are included in its representation, such as the fact that it is *affected_by* FLOODS. The meronymic relation is not represented at this general level because, depending on the kind of MARSHLAND ENVIRONMENT, its components can vary.

However, the structure of NATURAL GEOGRAPHIC OBJECT as a category is not always so straightforward. One might think that natural landforms are more or less the same all over the world, but the truth is that there is a great deal of plasticity in how language (understood as a manifestation of culture) models the earth and what is considered to be the essence of its features (Burenhult and Levinson 2008: 148). Evidently, this can present a problem for mapping between language-cultures at both the general as well as the more specific level.

One problem arises from the fact that we perceive the Earth's surface as objectively continuous, and thus segment it into different types of objects. Nevertheless, these divisions and the criteria used for this purpose can differ significantly from culture to culture. Until recently, it was believed that entities, such as MOUNTAIN and RIVER were candidates for universals (Smith and Mark 2001). However, research in cognitive ethnophysiography has found that this is not the case. A

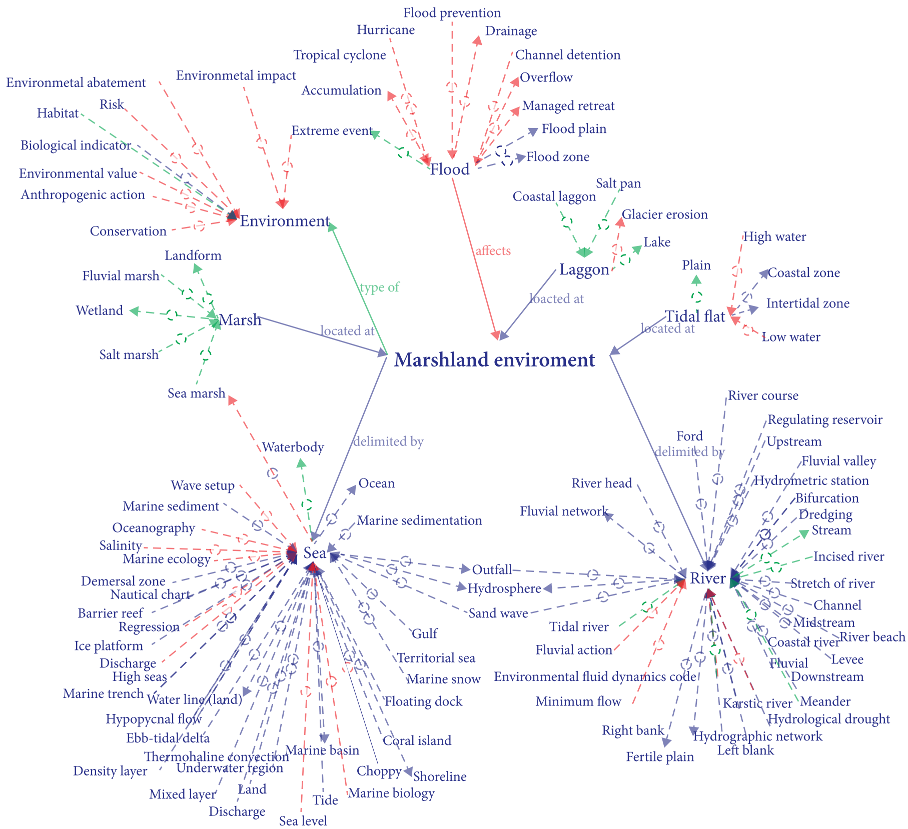

Figure 3. MARSHLAND ENVIRONMENT semantic network

MOUNTAIN is not necessarily a mountain in all cultures (Smith and Mark 2003), and certain (exotic) languages have no concept of RIVER reflected in their language (Levinson 2008). This means that geographic landforms do not come pre-segmented by Nature but arise from cultural perception. For landform concepts there appear to be three main hypotheses of category formation:

1. Categories are driven by perceptual or cognitive salience. This suggests that categories like MOUNTAIN, RIVER, LAKE, or CLIFF can be found in most (though not all) languages (e.g. There are no direct equivalents for these terms in certain exotic languages such as Yélî Dnye) (Burenhult and Levin 2008: 137).
2. Categories are driven by the affordances that they offer or the constraints that they impose on human activities. This suggests that there should be systematic variation according to subsistence patterns, ecology, and the technology of transport.

3. Categories are driven by conceptual templates and cultural beliefs. This suggests greater variation, with universals, if any, driven by universals of cognition, cosmology, or religious belief (Levinson 2008: 257–258).

Not surprisingly, the analysis of several exotic languages has shown that the structure of this category is often not the result of only one, but a mixture of the three. To make things more complicated, the elements in the mix can vary, depending on the culture and the language reflected. Thus, culture also has an important role in the representation of specialized knowledge, such as in the realm of geographic information systems (Burenhult and Levinson 2008; Mark, Turk, and Stea 2010), where landscape is usually conceptualized in an English-centered way. Despite the fact that EcoLexicon does not as yet contain non-European languages, cultural situatedness has also had an impact on our representation, where differences have been found even between closely related language cultures. Even within the same language, there are significant divergences as to how basic-level scientific concepts are categorized and segmented.

For instance, WATERSHED in American English covers a whole river basin, whereas in British and Australian English, it is more narrowly defined and only refers to the dividing line between two river systems. This means that within the whole of an American watershed, British and Australian scientists see several watersheds. *Drainage basin* and *catchment area* are other term variants that designate the American sense of *watershed*. They are sometimes used interchangeably and are other times used as a hyperonym of *watershed*, depending on whether *watershed* is used in its wider sense or as a dividing line. Furthermore, these variants also convey conceptual multidimensionality, since one focuses on how surface water drains *through* the basin and the other one on how water is collected *in* the basin.

Thus, the segmentation of the earth by physical dividing boundaries is often a source of lexical and conceptual gaps across cultures. Nevertheless, category membership may also be affected by the abstract dividing lines used in the parceling of specialized knowledge. An illustrative example of this is how WETLANDS are categorized. The diversity of wetlands has made it difficult for scientists to establish a single classification system. They have been classified according to environmental, geographical, hydrological, and ecological parameters, which have caused a significant degree of multidimensionality. Actually, the fuzziness of wetland categories may result from the fact that wetlands are themselves boundary landforms between aquatic and terrestrial ecosystems, and have different manifestations in different geographical regions.

One of the most widely known systems was proposed by Cowardin et al. (1979), who divided WETLANDS into MARINE, ESTUARINE, RIVERINE, LACUSTRINE and PALUSTRINE ENVIRONMENTS. Their system did not include deep water habitats or wetlands that resulted from human activities. Nevertheless, this category domain evolved into a paradigm shift, in the sense of Kuhn (1970), and new categories were proposed in the Ramsar Classification System for Wetland Types (Hails 1997), which aspires to cover all types of wetland in the world: MARINE/COASTAL WETLANDS, INLAND WETLANDS, and HUMAN-MADE WETLANDS. There are also African classifications based on specific wetland diversity and their position in the landscape. In turn, the Canadian National Wetlands Working Group (1997) established five classes: BOG, FEN, MARSH, SWAMP, and SHALLOW WATER.

However, naming categories after the terms of basic level concepts (Rosch 1978) might be confusing, because they are highly localized. The history of the use and misuse of these words has often revealed a regional or at least continental origin. Nonetheless, despite the standardization initiatives in recent years, each of these terms has a specific meaning for different groups of people, and many are still widely used by both scientists and laypersons alike (Mitsch and Gosselink 2011: 31).

For instance, *bogs* or *fens* are usually grouped together and referred to as *mires* in Europe, but not in America. *Marshes* in Europe are often called *reed swamps*, but swamps in America are not dominated by reeds but by trees. *Carr* is the northern European way of referring to the Southeast American *wooden swamp*, which in the United Kingdom is also called *wet woodland*.

There are also specific types of wetlands that are only predominant in certain geographic areas that are not lexicalized in all cultures, such as the Australian *billabong*, the African *dambo* or the Canadian *muskeg*. In these cases, the local terms are only borrowed when describing these particular wetlands. Thus, when one of these terms is activated in a text, the location-related category features of the concept are constrained. Consequently, within the international scientific community, these terms do not always convey the same meaning. In fact, some languages have no equivalents for certain types. The word *swamp* has no equivalent in Russian because in Russia there are few forested wetlands that are not simply a variety of peatlands (Mitsch and Gosselink 2011: 31).

The dynamics of wetland categorization can also be observed in the formation of *ad hoc* categories. Most of the wetlands of the world are not located along the coastlines but in interior regions. These wetlands are called *nontidal* in coastal regions to distinguish them from coastal wetlands. However, no such term is used by inland wetland scientists (Mitsch 2009: 88).

7.5.2.2 *Artificial geographic features*

Artificial geographic features constitute a similar category, since they are also integrated in the landscape. However, there is a clear distinction in their category template. First of all, as man-made entities, artificial geographic objects have an impact on the landscape, which is directly related to their purpose. Secondly, artificial objects may be made of different materials, which are in turn closely related to their functions and attributes. As a result, they add functional and material dimensions (*has_function, made_of*) and reduce the focus on boundaries (*delimited_by*) (Table 3).

Table 3. ARTIFICIAL GEOGRAPHIC OBJECT category template

ARTIFICIAL GEOGRAPHIC OBJECT	
type_of	Type of construction
has_part	Parts of the construction
made_of	Material used in the construction
located_at	Place where the construction is located
has_function	Function of the construction
attribute_of	Shape, height, permeability, etc. of the construction

As depicted in Figure 4, GROYNE is a type of HARD DEFENSE STRUCTURE, which may be made of WOOD, CONCRETE, or RUBBLE-MOUND. It may be composed of a BERM and a CORE and can have several functions, such as RETARD LITTORAL DRIFT. As for the *type_of* relations, they can be regarded as access routes to subordinate level concepts, such as Y-SHAPED GROYNE or HIGH GROYNE (observe that size and shape are still category features in ARTIFICIAL GEOGRAPHIC OBJECTS). The representation of GROYNE also includes the relation *delimited_by*, but this time the arrow points in the opposite direction. The proposition GROYNE BAY *delimited_by* GROYNE illustrates how artificial geographic concepts no longer have explicit boundaries, but rather act as the boundaries for natural ones.

Once more, it might initially seem that the category of ARTIFICIAL GEOGRAPHIC OBJECT would not be susceptible to cultural variation, but it is as culture-bound as NATURAL GEOGRAPHIC OBJECTS. Generally speaking, this variation is often reflected in the dimensions of *position*, *location* and *function*. First of all, the structure of this category is not homogenous throughout the world. COASTAL DEFENSE STRUCTURES are generally classified in three main categories: SHORE-PERPENDICULAR STRUCTURES, SHORE-PARALLEL OFFSHORE STRUCTURES, and SHORE-PARALLEL ONSHORE STRUCTURES. This categorization is based on *location* (shore), *position* (perpendicular or parallel), and the *distance* (offshore or onshore) from the structures to the coast.

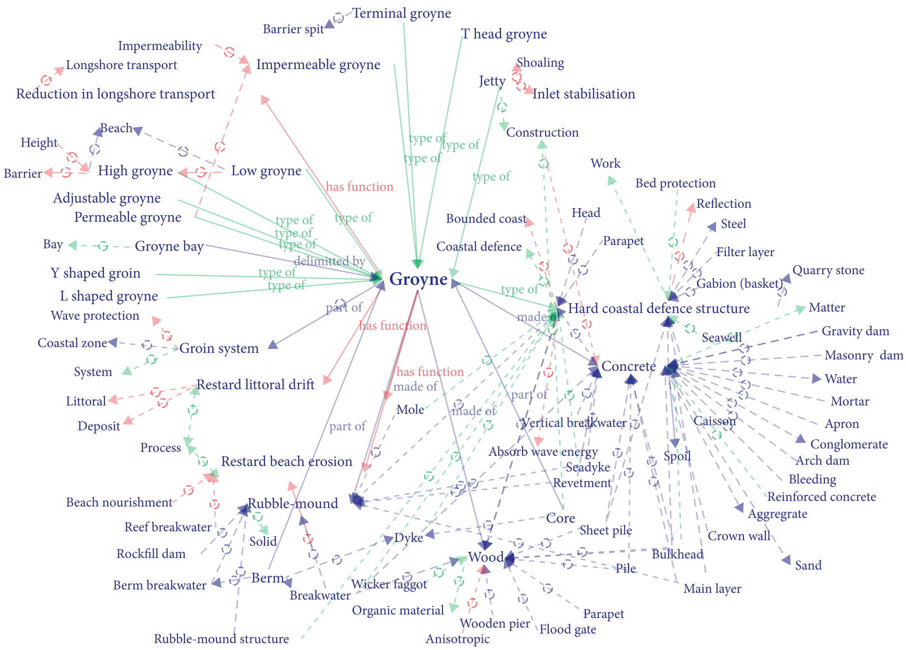

Figure 4. GROYNE semantic network

Spanish reflects a similar categorization though with certain variations: DEFENSAS LONGITUDINALES, DEFENSAS TRANSVERSALES, DEFENSAS EXENTAS. *Longitudinal* and *transversal* are equivalent to *perpendicular* and *parallel* despite the fact that the dimension of *location* is not included. However, the distinction implicit in *onshore* and *offshore* is not considered because *exento* is the only term that codifies the distance of coastal structures, which actually means *separated* (from the shore). In turn, in Australian texts, another categorization is found: BEACH STABILIZATION TREATMENT STRUCTURES and SHORE STABILIZATION TREATMENT STRUCTURES, all of which refer to the *function* of these structures (stabilization) and the patient or affected entity (shore or beach).

In this domain, specialized terms are also subject to geographical variation even within the same language. For instance, the concept PIER is often designated as *jetty* in the Great Lakes, whereas a JETTY is a structure designed to prevent the shoaling of a channel and not a recreational area. However, in British English, *jetty* is the synonym of a *wharf*. In contrast, in American English, *pier* may also be a synonym of *dock*. Nevertheless, in British English a DOCK is the area of water used for loading or unloading cargo in a HARBOR, which in American English is called a *port*.

Geographical variation in this category domain is often conceptually motivated and mainly based on the dimensions of *location* and *function*. For instance, a DIKE may be called a *levee* when it is located on a river, whereas a BREAKWATER may be called a *mole* when it is covered by a roadway. On the contrary, when a BREAKWATER serves as a PIER, it is called a *quay* in British English and a *wharf* in American English.

Coastal structures are constructed for different reasons. Moreover, their function can vary depending on their regional location. The terms used to designate them thus nuance their meaning across different language cultures. For instance, a JETTY often has the same shape as a BREAKWATER, but location and function constrain the meaning of the concept and thus, the way it is designated.

7.6 Domains as specialized knowledge fields

As has been shown, concepts within a domain are internally constrained by the nature of categories. When domains are conceived of as specialized knowledge fields, such as CHEMISTRY, GEOLOGY or CIVIL ENGINEERING, they add new constraints based on cross-disciplinary differences that provide a new source of dynamicity. As Kristiansens (in this volume) points out, scientific knowledge is by nature dynamic, and scholarly areas, together with their concepts and terms, will develop and change gradually over time and due to multidisciplinarity.

The same happens with the environmental domain, which is a relatively new knowledge field that relies on many others, ranging from GEOGRAPHY to CIVIL ENGINEERING. Nevertheless, although the environment has already experienced certain paradigm shifts, rather than focusing on the diachronic aspect of dynamicity, we prefer to examine the effects of multidimensionality since not all disciplines deal with environmental concepts from the same perspective. In EcoLexicon, cross-disciplinary constraints add further contexts and background situations in which certain versatile concepts are reconceptualized (León-Araúz, Reimerink, and Aragón 2013; León-Araúz and Faber 2010; León-Araúz, Magaña, and Faber 2009). In our approach, we focus on the salience of conceptual propositions within different discipline-oriented settings or contextual domains.

In this sense, in EcoLexicon, we are currently working to establish contextual field-related constraints on the activation of conceptual relations. This is being applied to general objects and processes, such as WATER, OCEAN, SEDIMENTATION, EROSION, etc., which otherwise would generate an excess of information. This is due to the fact that multidisciplinarity gives rise to fuzzy category boundaries and as a result, contextual domains can form their own hierarchical structure. Moreover, they are also dynamic flexible structures that should evolve over time according to the type and amount of information stored in our knowledge base (León-Araúz and Magaña 2010). In this sense, domains categorized as knowledge fields can also be regarded as culture-bound since they can project different world-views in different cultures, and this inevitably affects the way that specialized knowledge concepts are designated.

7.7 Conclusion

Dynamicity is a crucial issue in Terminology because it is at the root of specialized communication and knowledge representation. However, it is rarely reflected in terminological resources. Reasons for this include the difficulty of portraying dynamic events by means of static conceptual trees, given that such representations stem from standard theories of cognition, based on the abstract, amodal representation of entities, events, and processes. However, a more dynamic view of cognition, derived from recent research in neuroscience, claims that understanding is largely based on sensory and motor simulation with possibly a single convergence zone that affords the possibility to generalize across concepts that have similar semantic significance.

Furthermore, dynamicity is also manifest in the culture-bound conceptualizations of entities and their designations in different languages-cultures. The examples given in this chapter show that specialized language units can have a strong cultural component that should be integrated in their conceptual representation. Consequently, term variation should not be regarded as a linguistic phenomenon isolated from contextual and cultural considerations.

This has evident applications to Terminology and its dynamic nature, which include the following:

1. No specialized knowledge concept should be activated in isolation, but rather as part of a larger structure, context, or event.
2. A specialized knowledge resource that facilitates knowledge acquisition should thus provide conceptual contexts or situations in which concepts and terms are related to others in a dynamic structure that also takes cultural information into account.
3. Since knowledge acquisition and understanding requires simulation, this signifies that non-hierarchical relations defining the goal, purpose, affordance, and result of the manipulation and use of an object are just as important as hierarchical generic-specific and part-whole relations.
4. Research proposals, such as the domain-specific hypothesis (Caramazza and Shelton 1998) also has implications for Terminology since it asserts that

domains are constrained by the nature of their members. In Terminology, this is reflected in clusters of conceptual relations that make up the general representational template, characterizing different categories.

5. Cultural differences are crucial because knowledge is not accessed in the same way by all cultural communities. Term variation is often conceptually motivated based on the same features that characterize domain categories. This can lead to valuable insights into how culture influences human categorization.

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