

Chapter 17. Conceptual metaphors

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Abstract. This chapter offers an overview of conceptual metaphor research with particular attention to specialised language. It surveys the growing body of research showing the role of metaphor both as a tool to generate and develop scientific thinking and as a resource for specialised knowledge popularisation. This chapter also addresses specialised language studies that explore not only the embodied but also the socio-cultural dimension of metaphor in terminology, thus crucially refining conceptual metaphor theories and typologies in all spheres of communication.

Keywords: conceptual metaphor, Cognitive Linguistics, metaphor types, specialised language discourse, terminological figurative language, non-terminological figurative language

1. Introduction

The present chapter offers an overview of conceptual metaphor research with special emphasis on specialised language. Section 2 gives an overview of conceptual metaphor research in general from a Cognitive Linguistics perspective. Recognised as a way to make sense of our experience, and thus central to a theory of knowledge (Lakoff 1987), metaphor has been approached from a lexical (Evans 2004), grammatical (Goldberg 1998) and pragmatic viewpoint (Sperber and Wilson 1986). Section 3 focuses on the significance of metaphor in specialised language and Terminology. Specifically, this second part surveys the growing body of research showing the pivotal role of metaphor both as a tool to generate, develop and communicate scientific and domain-specific thinking and as a resource for specialised knowledge popularisation. This section also addresses specialised language studies that explore not only the embodied but also the socio-cultural dimension of metaphor in terminology, thus crucially refining conceptual metaphor theories and typologies in all spheres of communication.

It should be highlighted that until the late 1970s, it was generally thought that metaphorical expressions and figurative language in general, had a marginal role in science. Indeed, Ortony (1993, 1) notes that, in the past, scientific and technological knowledge was regarded as precise and unambiguous. Hence, metaphor was believed to be unnecessary in scientific expression since meaning extensions lead to polysemy and, as a consequence, to misinterpretation and unscientific communication. Conceptual metaphor was later proven to have a direct bearing on the way (i) the human mind creates and categorises specialised concepts; and (ii) on the way such concepts are

conveyed through language to structure and further all fields of expertise (cf. e.g., Alexiev 2005; Caballero 2006; Temmerman 2000; Ureña 2011; Ureña and Faber 2010).

For all these reasons, conceptual metaphor research has been highly instrumental and insightful in revealing fundamental aspects of human thought, language, and interaction that are central to scientific development and specialised language description. It can thus be concluded that conceptual metaphor theories — as will be shown — can be regarded as essential to terminology studies.

2. Conceptual metaphor: Emergence, underpinnings, and typologies

This section focuses on the emergence, development, classifications and applications of the notion of conceptual metaphor from the perspective of Cognitive Linguistics in its different manifestations. In line with the natural chronological evolution of conceptual metaphor, its description begins from a general language perspective; however, this section also includes examples of terminological metaphor (figurative expressions from specialised language) to opportunely illustrate its relevance to the reader.

2.1. Cognitive Linguistics and Conceptual Metaphor

Over the past four decades, cognitive linguists (e.g., Lakoff 1993; Lakoff and Johnson 1980, 1999; Steen 2007, 2008; Kövecses 2002, 2005, 2015; Gibbs 2011) have gathered linguistic and experimental evidence that shows that metaphoric thought is central to reasoning and, as a result, pervasive and ubiquitous in human communication. This means that metaphor not only operates as a mere stylistic/ornamental and emotion-arousing tool in poetry and literature, but it underlies ordinary language and everyday (inter-)action. More specifically, metaphor has been shown to be a foundational, and thus, an essential instrument of the human mind to generate and structure thought and to get it across in communication (Gibbs 2011).

This finding has its roots in Experientialism, a philosophical theory of life that arose in the 1970s to take the place of the more traditional (and opposed) perspectives provided by Objectivism/Positivism and Subjectivism. The experientialist view contends that truth is relative to our conceptual system, which is grounded in our experience. In language description, Experientialism was channelled through Cognitive Linguistics, a school that emerged in the early 1970s out of dissatisfaction with formal approaches to language (Evans and Green 2006, 2).

Pioneered by Lakoff and Johnson (1980), Cognitive Linguistics holds that thought is largely based on imagery, i.e., metaphor, metonymy, and other figurative processes which go beyond the literal representation of reality (see also Lakoff 1987, 1993; Lakoff and Johnson 1999). These ideas lie at the origin of Conceptual Metaphor Theory, then expanded into what has been termed Conceptual Metaphor and Metonymy Theory (Dirven and Ruiz de Mendoza 2010, 38).

A conceptual metaphor consists in “understanding and experiencing one kind of thing in terms of another” (Lakoff and Johnson 1980, 5), where by “thing” is meant a domain of experience, which is structured in the form of an *idealised cognitive model*, i.e., a principled knowledge construct which captures aspects of our experience of the world. More specifically, conceptual metaphor involves *systematic mappings* (or sets of correspondences) between concrete and abstract conceptual domains (i.e., between the *source* and *target* domains, respectively) (Lakoff and Johnson 1980, 246). These metaphorical mappings, which structure our reasoning and our everyday language, “grow out of an *embodied* conceptualisation of reality”, that is, they arise from “the ways in which our species-specific *bodies* interact with the environment” (Evans and Green 2006, 27) [our emphasis]. In other words, everything that affects the nature of our experience, mind, and language cannot be studied in isolation from the configuration and conceptualisation of our bodies. This is what is known as *embodiment* (Lakoff and Johnson 1980, 55–56; 1999, 91).

For example, expressions from the field of Economics — such as “The value of shares in the New York Stock Exchange *rose* unexpectedly” and “Financial assets, among other stocks on the market, *plummeted* all of a sudden” — instantiate the metaphors MORE IS UP and LESS IS DOWN, respectively. As Lakoff and Johnson (1999, 47) explain, these conceptual metaphors arise because a subjective judgment of quantity is conceptualised in terms of the sensorimotor experience of verticality. This happens because of our experience with seeing levels either rise as larger and larger amounts of substances accumulate or drop as amounts gradually decrease.

Subsequently, other four major theories of metaphor, with a clear cognitive orientation, were developed¹. Two of these theories were formulated within Cognitive Linguistics: (i) Blending Theory (BT) (e.g., Fauconnier and Turner 1996, 1998, 2002), which focuses on the conceptual structure that emerges from combining source and target inputs to metaphor; and (ii) Primary Metaphor Theory (Grady 1997a, 1997b, 1999, 2005; Grady and Johnson 2002), which argues that

¹ This chapter only mentions those theories that have been fruitfully applied in terminology studies. See Steen (2007) for a full account and detailed comparison of all theories of metaphor within Cognitive Linguistics.

traditional metaphors can be reduced to more basic mappings that directly arise from primary experience (e.g., LOVE/LIFE/A CAREER IS A JOURNEY are enrichments of GOALS ARE DESTINATIONS). Outside Cognitive Linguistics, but also involving a cognitive orientation, is the Career of Metaphor Theory (e.g., Gentner and Rattermann 1991; Gentner and Bowdle 2001; Bowdle and Gentner 2005), which associates more conventional metaphors with cognitively more expensive analogical processes and less conventional ones with a more efficient categorization of the target into a more abstract category cued by the source.

This chapter goes on to show in what ways and to what extent these cognitivist approaches to figurative thought and language have been useful to terminological metaphor description. At this point, it is worth mentioning that these theories lie at the heart of a growing body of studies that look into the nature of metaphor at all levels of linguistic description and explanation. For example, Lakoff (1987), Tyler and Evans (2003), and Evans (2004) take a lexical perspective, Goldberg (1998) studies metaphor from a grammatical point of view, and Sperber and Wilson (1986) as well as Ruiz de Mendoza and Galera (2014) focus on the pragmatic aspects of figurative thought and language. Figurative linguistic instantiations can be addressed through the traditional qualitative, intuition-based methodology of metaphor examination or through a corpus-based/driven methodology (see Kövecses et al. 2019, for the advantages and disadvantages of the two methodological approaches).

2.2. Conceptual metaphor typologies

A programmatic account of conceptual metaphor classifies it into types. Lakoff and Johnson (1980, 3) were the first to suggest the basic types of verbal metaphor that can occur in speech and writing. Accordingly, metaphors are classified into three different groups: orientational, ontological, and structural metaphors. The first type of metaphor organises thought by providing a spatial orientation based on the configuration and functioning of our bodies (Lakoff and Johnson 1980, 14). Thus, orientational metaphors provide evidence that states of mind, feelings, and other abstract concepts can explicitly be related to physical orientations in order to explain the relation between our thoughts and movements verbally. As an example, Lakoff and Johnson (1980, 15) suggest the metaphors HAPPY IS UP and SAD IS DOWN, which are grounded in the empirical fact that we tend to slouch when feeling sad and stand and walk up straight when feeling happy. This rationale enables the use of metaphorical expressions in medicine, as in “Following pill administration, the

concentration of free serotonin in the patient's brain was *on the increase*, and thus, his mood/spirits *rose*".

Ontological metaphors are a very helpful resource when explaining abstract concepts which are difficult to understand literally. In fact, they are naturally used to explain disembodied concepts such as emotions, states of mind and purely abstract ideas through objects, substances, containers, or people (Lakoff and Johnson 1980, 31). One common situation where we use ontological metaphors is the description of the human mind, which is understood in terms of a tangible object. For instance, we view states of mind as boxes into which we can put things and from which we can take things out by using metaphors such as "Due to sustained strain, the patient *fell into a depression*".

Structural metaphors are the most complex ones because "understanding takes place in terms of entire domains of experience and not in terms of isolated concepts" (Lakoff and Johnson 1980, 117). This means that the whole or a substantial portion of the source domain is mapped onto the target domain. An illustrative example in the domain of civil engineering is CONCRETE IS THE SKIN OF A CONSTRUCTED STRUCTURE, which is pervasive in this specialised knowledge field (Boquera 2005, 198). This structural metaphor underlies a great many metaphorical terms such as "The concrete of our building is *weeping/bleeding* because it is running out of humidity" and "The cover of the old bridge is *alligatoring* due to excess vibration". Spanish-language engineers usually make the following statement: "Cuando llueve abundantemente, el hormigón de poco espesor *se entumece*" [literally, "Whenever it rains heavily, thin concrete becomes *numb*"]. It can thus be concluded that this conceptual metaphor is recurrent in Western culture, where we are inclined to associate building materials with human skin and body parts. Therefore, the metaphor CONCRETE IS THE SKIN OF A CONSTRUCTED STRUCTURE is not used arbitrarily, but is the result of the impact of our cultural background. In this way, "we structure our experience — and it naturally emerges — from our activity in the world" (Lakoff and Johnson 1980, 119).

Unlike conventional (structural-conceptual) metaphors, image metaphors build upon one-shot comparisons, i.e., only one concept of the source domain maps onto the target domain, and thus, an image metaphor is conceptually simple (Lakoff 1993, 229; Lakoff and Turner 1989). Importantly, image metaphors arise from sense-perceived resemblance (similarity), which involves comparison in terms of physical features such as shape, colour, and size. The image metaphor versus the structural-conceptual metaphor dichotomy is a correlation of the one-

correspondence metaphor versus the many-correspondence metaphor typology suggested by Ruiz de Mendoza (1997). A one-correspondence metaphor results from a single cross-domain correspondence or mapping, and is thus not a part of a productive, many-correspondence metaphor.

The definition of image metaphor — and ultimately of resemblance metaphor — was later refined by Grady (1997a, 1997b, 1999). Based on the analysis of figurative expressions such as “Achilles is a lion”, Grady (1999, 89) distinguishes between behaviour-based metaphor in contrast to image metaphor. The former involves resemblance grounded in action/physical activity (in the previous example, Achilles’ courageous actions resemble the aggressive behaviour of lions) without no reference to physical appearance. However, the latter entails a comparison in shape, size or colour, thus based on static features. For example, the contour/shape of a river compared with that of a wool thread triggers the image metaphor A RIVER IS A WOOL THREAD.

Grady’s (1997a, 1997b) Primary Metaphor Theory differentiates between primary metaphors², which are atomic or minimal structures that automatically and unconsciously arise from everyday experience by means of conflation, and compound metaphors, which are molecular (i.e., complex/composite) structures growing out of primary metaphors. Conflation (first suggested by Johnson 1997) refers to young children merging their subjective (non-sensorimotor) experiences and judgments, on the one hand, and sensorimotor experiences, on the other, so that they become undifferentiated and undistinguishable when they co-occur in everyday interaction (Lakoff and Johnson 1999, 46). Examples of these two types of metaphor are provided in subsection 3.2.

Ruiz de Mendoza and Pérez (2011) take a multi-perspective approach to metaphor classification, based on the following parameters: (i) the ontological nature of the source domain, which elaborates on Lakoff and Johnson’s initial distinction into ontological, structural, and orientational, by expanding orientational metaphors into image-schematic metaphors, and then, by adding other categories like image metaphors (e.g., “A horse with a mane made of *rainbows*”, which uses specific images to provide a vivid picture of some aspects of the target), and situational metaphors (e.g., “He ran away with his *tail* between his *legs*”, which depicts a situation in the source); (ii) the nature of the mapping system (which incorporates the one-correspondence/many-

² See Lakoff and Johnson (1999, 50–54) for a list of the most representative primary metaphors suggested by Grady (1997a).

correspondence distinction); (iii) the level of genericity of the target domain (which calls for a distinction between high and low-level mappings); (iv) the degree of complexity of the metaphoric operation (which expands Grady's distinction between primary and compound metaphors by contemplating the existence of metaphoric amalgams of various kinds, as in "She *got* the *idea across* to me", which combines into one IDEAS ARE MOVING OBJECTS and UNDERSTANDING IS GRASPING/SEEING).

Finally, there is the distinction between deliberate and non-deliberate metaphors, put forward by Steen (e.g., 2008, 2017) in his Deliberate Metaphor Theory. The former provides an innovative perspective on a topic. We find examples of deliberate metaphors in studies of molecular biology education and its terminology, as in the sentence "You could actually make sort of *Frankenstein* hybrid transcription factors with cloning techniques" (Beger 2016, 68). Using FRANKENSTEIN as a source domain for the process of separating and reassembling transcription factors is absolutely unconventional. In contrast, non-deliberate metaphors are not used as such by speakers, not even by specialists in diverse knowledge fields. For instance, the conceptual metaphor MARINE HABITATS ARE COMMUNITIES, which depicts marine life as a complex and competitive social structure, is not deliberately exploited as a metaphor by marine biologists. A clear example is seen in the following sentence, extracted from a marine biology research article: "In a sex–role reversed *population* of the *peacock* blenny, *Salaria pavo*, two alternative male types [...] mimic female–*courtship* behaviour and *nuptial* colouration in order to try to *sneak* fertilizations during spawning episodes" (Ureña 2011, 167).

On the basis of experimental evidence, however, Gibbs (2015) has argued that the notion of "non-deliberateness" in metaphor often lacks cognitive plausibility and should make explicit the pragmatic and conceptual signals which support their interpretation for adequate experimental testing (and consequent empirical support) to be possible.

3. Metaphor in Terminology and domain-specific language discourse

As previously mentioned, it was not until the late 1970s that figurative language began to gain momentum in science description and in the philosophy of science. Furthermore, in ordinary language research, cognitive linguists in the 1980s and 1990s, such as Lakoff (1987) and Turner and Fauconnier (1995), argued that metaphor, being primarily a matter of thought, also permeates the terminology of domain-specific and specialised language domains. Earlier on, metaphorical

expressions were considered too vague and inaccurate to be used in specialised language discourse. This view is somewhat paradoxical, given the pivotal role which philosophers of science started to ascribe to metaphor and metonymy in the development of scientific theories and in the description and explanation of complex concepts to laypeople and also to semi-specialised audiences (Boyd 1993; Hesse 1966; Kuhn 1979; Brown 2003 *inter alia*).

The lexical and conceptual nature of domain-specific metaphor as well as the interplay of the conceptual underpinnings and discursive (pragmatic and rhetorical) functions of metaphor have been explored in an extensive body of research all the way through to the 21st century either from a monolingual (mostly English) or inter-/cross-linguistic perspective. Much of this research now relies on the compilation, processing, and analysis of (large) computerised text corpus datasets by means of (semi-)automatic metaphor identification techniques. The standard theoretical framework for studies focusing on the lexical-conceptual dimension of specialised language metaphor is Conceptual Metaphor Theory. On this basis, metaphor has been investigated in diverse knowledge fields. For example, Brdar, Brdar-Szabó and Perak (2019) conduct a cross-linguistic analysis of transplant surgery metaphorical terms that reveals mismatches between the consistent pair Croatian–Hungarian, on the one hand, and English and French, on the other, in conceptualising domain-specific entities and processes (non-)metaphorically. This research highlights the suitability of constructing multi-lingual conceptual metaphor system repositories for unbiased, more integrative content description and representation.

By harnessing a civil engineering data corpus, Alexiev (2005) accounts for conceptual, linguistic and cultural differences and commonalities of metaphorical terms in English, Bulgarian and Spanish for translation purposes. By applying a set of highly productive strategies for the semi-automatic identification of marine biology terms in a corpus of specialised research articles in English and Spanish, Ureña and Faber (2011) reveal inter-linguistic similarities and differences in the conceptualisation of sea organisms through metaphor.

As for corpus-based, cognitive-oriented studies with a markedly discursive approach to domain-specific metaphor, many of them draw on Critical Discourse Analysis³ in conjunction with Conceptual Metaphor Theory and Blending Theory. For instance, in dealing with gender, Koller (2004) examines how *metaphor* can be employed to position people in *gender roles by analysing a political text corpus. To address the topic of race based on conceptual blending premises, Hart*

³ This is an interdisciplinary approach to discourse that views language as a form of social practice.

(2008) looks at the metaphorical constructions of nation, immigration, and immigrants in election manifestos. In business and politics, Charteris-Black (2014) offers insightful guidelines to perform political speech analysis, where metaphoric thought and language play a major role. Koller (2006) shows the suitability of using electronic text corpora to study metaphor in business media discourse.

Musolff (2016) discusses the widely debated political metaphors WAR, FAMILY, BODY and PERSON, identified in a bilingual English-German corpus collected from the press dealing with European politics. Sweetser, David and Stickles (2019) implement a methodology to detect metaphors from the target domain of TAXATION by analysing grammatical constructions extracted from corpora in English, Farsi, Russian, and Spanish. By analysing English-language tennis reports and online fora, Caballero (2012) sheds light on the *empathetic* and *evaluative* role of metaphor as a communicative strategy in sports discourse.

Once that terminological metaphor has been briefly presented, the following subsections describe how terminologists have studied metaphorical terms. In fact, they have been able (i) to make ground-breaking contributions to the understanding of conceptual metaphor by applying it to terminology; and in some cases (ii) to refine the metaphor types initially proposed by general language metaphor researchers.

3.1 Challenging Boyd's typology: Novel and deliberate metaphors in scientific circles

As previously mentioned, philosophers of science aptly claim that “metaphor is important in theorising and can be a part of the theory” (Hoffman 1980, 416). Boyd (1993) makes an important contribution to philosophy of science by distinguishing between *theory-constitutive metaphors*, *heuristic metaphors* and *exegetical/pedagogical metaphors*. The first ones are intrinsic and foundational to certain scientific theories and formulations, and thus, they cannot be paraphrased in literal terms. A stock example is the metaphor THE HUMAN BRAIN IS A COMPUTER, which gives rise to statements such as “Thought is a type of *information processing*” and “Learning is an adaptive response of an *auto-controlled machine*” (Boyd 1993, 486).

Though not pre-theoretical, heuristic metaphors help develop theories and support scientific knowledge by solving or presenting new approaches to problems specific to each specialised discourse. They are used when it is difficult to express theoretical premises literally, or even when direct observation is not possible. The expression “information highway”, used to refer

to the Internet, is an instance of heuristic metaphor. Both theory-constitutive and heuristic metaphors are linguistically realised as metaphorical *terms*, namely, well-entrenched expressions with specialised meaning in the lexicon of scientific discourse.

Finally, exegetical metaphors do not transmit new scientific thought. They only play a role in “the teaching and explication of theories of science and technology which already admit of entirely adequate non-metaphorical (or at any rate less metaphorical) formulations” (Boyd 1993, 359). Examples of pedagogical metaphors are “worm-holes” in general relativity, the description of the spatial localization of bound electrons in terms of an “electron cloud”, or the description of atoms as “miniature solar systems” (*ibid.*).

Because metaphor had initially been regarded as inexistent in scientific circles, systematic cognitive-linguistic research on metaphor in subject-oriented and specialised knowledge domains only began in the 1990s. This fact explains why embryonic studies of metaphor in diverse fields of expertise clung to Boyd’s (1993) *watertight* classification of metaphors in science and technology. Research in this vein was conducted in the fields of computer science (Meyer, Zaluski and Mackintosh 1997), economics (White-Hayes 1996), medicine (Tercedor 1999), publicity (Cortés de los Ríos 2001), and science teaching (Bradford and Dana 1996), to name but a few.

Challenging Boyd’s (1993) monolithic metaphor typology in specialised communication, Knudsen (2003, 2005) notes that the dividing line between theory-structuring and pedagogical metaphors is fuzzier than initially assumed. For example, Knudsen (2003, 1261) shows that the GENES ARE A LINGUISTIC CODE metaphor (e.g., “Once a gene has been *transcribed* into *messenger* RNA, those unwanted stretches of *transcript* have to be *deleted*”) started out as a pedagogical (i.e., science popularising) metaphor, which was transformed into a theory-constructive one, and now is generally used again in non-expert communicative settings as well.

In the same direction, Ureña (2016) draws on premises from the Career of Metaphor Theory (Bowdle and Gentner 2005) to analyse empirical textual data from academic marine biology journal articles. Ureña (2016) demonstrates that novel and spontaneous metaphors are sometimes used by biologists to address their peers in formal expert-expert communication with a view to: (i) explaining and describing findings in the field in a highly creative — and at the same time — effective manner; and (ii) humorously bringing the readership’s attention to the claims made in their articles with playful analogies (rhetorical and discursive purpose). In this study, the array of novel metaphors is shown to be systematically exploited in order to conceptually structure and

give thematic coherence to a whole specialised discourse event dealing with school fish behaviour. These creative metaphors, some of which are grounded in metonymy, may be either non-terminological lexical items and expressions or terminological units borrowed from other specialised knowledge fields.

An example of non-terminological metaphors identified in Ureña (2016) is “*club* members do not *lift a fin(ger)*”. This metaphorical sentence is used by the author of the article to explain that whenever a fish school has a “free rider” (individual fish which advances under water on the swimming efforts of its schooling partners or “*fellow club* members”), this fish will be automatically excluded by guard fish with the implicit consent of the rest of school members. The author of the article uses the informal, ordinary language idiom “not to lift a finger”, which means “not making any effort at all to do something, especially to help somebody”, to construct an adapted version of this idiom that exploits the pun “fin(ger)” [fin (fish body part) + finger (human organ)]. The interesting aspect of this rhetorical figurative device is that it is used to describe school fish behaviour and dynamics (domain-specific information) in a specialised knowledge domain context.

In the field of Ecology, Thayer (1979) suggests the novel terminological metaphor “biological bulldozer”, a phrase borrowed from civil engineering terminology, to refer to those bioturbators that modify and shape marine ecosystem surfaces (such as the seabed) by burrowing, ingestion, and defecation of sediment grains. This once creative metaphor became a well-entrenched term when — partially inspired by Thayer — Jones, Lawton, Shachak (1994) systematically developed the Ecosystem Engineering theory. On this basis, they proposed the terminological unit, *ecosystem engineers*, and began to use the metaphorical noun “bulldozer” in verbalised forms, as in the sentence, “The European *periwinkle* (*Littorina littorea*) *bulldozes* sediments from hard substrates” (Jones, Lawton and Shachak 1994, 376). As they put it, this terminology was necessary since “the role of organisms in the creation and maintenance of habitats had previously neither been defined nor systematically identified and studied” (Jones, Lawton and Shachak 1994, 373).

Novel metaphoric expressions *deliberately* exploited in specialised scientific settings are thus closely related to the notion of *deliberate metaphor* suggested by Steen (2008, 2017) and defined in subsection 2.2. On this basis, Ferella (2020) analyses deliberate metaphor usage in three Hippocratic treatises and in Empedocles’ two famous similes. Ferella examines direct metaphors

— as she also names them— through their textual markers with a view to testing the illustrative as well as heuristic communicative functions of these metaphors in ancient Greek anatomical and physiological dissertations. She concludes that these are deliberate metaphors because the authors who exploit them claim to use them as metaphors, leaving their addressees no option but to recognise the source domain as such (Ferella 2020, 129). For example, a Hippocratic author establishes the novel deliberate metaphors, FEMALE WOMB IS AN OVEN, FOETUS GROWTH PROCESS IS BAKING, and MEMBRANES ENCOMPASSING THE SEED (FOETUS) ARE THE CRUST OF BREAD (there is scientific evidence that the foetus forms a membrane around itself when it inflates with air; hence the *membranes-crust of bread* comparison). This network of spontaneous, deliberate metaphors comes into being because the maternal uterus is thought to be hot (Ferella 2020, 136).

2.2. Compound and primary metaphors and image-schematic metaphors

As mentioned in subsection 2.2, research on metaphors in subject-oriented vocabulary also concerns compound, and thus, primary metaphors. An example of compound metaphor in politics and business is COMPLEX ABSTRACT SYSTEMS ARE PLANTS, which arises from the primary metaphor ABSTRACT COMPLEX SYSTEMS ARE PHYSICAL OBJECTS. Accordingly, we can build sentences such as “Please turn to the local *branch* of the organisation” and “Government and educational bureaucracies should be *pruned*” (Kövecses 2005, 209, 210). In the same vein, Taylor and Van Every’s (2000) formulation of scientific management, which involves a mixture of mechanical engineering and social physics, conceives social behaviour in organisations as following deterministic, natural patterns; that is, workers need to be selected on the basis of their adequacy to a particular pre-specified task and can be characterized in units of energy — hence the compound metaphor ORGANISATION WORKERS ARE FOOT-POUNDS OF ENERGY (Cornelissen and Kafouros 2008, 966). Taylor is thus using the conventional primary metaphor ORGANISATION IS A PHYSICAL STRUCTURE (a machine, in this case) to conceptualise an organisation in terms of an object’s concrete structure with physical parts, which in turn represent the different elements of the organisation.

From a monolingual perspective, Yu and Tay (2020) draw on Corpus Linguistics as well as discourse and statistical analysis to eventually find a strong correlation between image-schematic metaphors and the themes of anger, anxiety, and depression in an English-language specialised corpus of therapeutic transcripts. Image schemas such as FORCE (e.g., “It is hard to *pin*

anger *down*”) and VERTICAL ORIENTATION (“Anxiety *builds up*”) are shown to be among the commonest types of image-schematic metaphors used by patients to describe the therapeutic themes of anger, anxiety, and depression. Importantly, this research has implications for how image-schematic metaphors can be used to facilitate the descriptions of the above-mentioned topics in therapeutic conversations (Yu and Tay 2020, 253).

2.3. Refining the theory of resemblance and non-resemblance metaphors in specialised language

Specialised language metaphor theory has substantially benefited from studies of conceptual metaphor either from a lexical (terminological meaning) or a discursive (rhetoric and genre) perspective. Alexiev (2005, 40) explains that “conceptual aspects of terminological metaphor involve the mechanism of metaphorization, key conceptual themes underlying the metaphorical terms in a given terminology, motivation for metaphorical transfer and distinction between conventional (conceptual) and image (one-shot) metaphors”. Important refinements concerning the two latter points are made by Ureña and Faber (2010) in their lexical semantic study of marine biology terms and Caballero (2006), who explores the creative power of metaphors in architecture from a conceptual and rhetorical perspective.

In regard to image metaphors in Terminology, Ureña and Faber (2010) remodel the traditional watertight sub-category division between image metaphors and behaviour-based metaphors (Grady 1999) by carefully considering the motivations for metaphorical transfer underlying terminological designations of sea organisms. Based on a cognitivist approach to such terms, Ureña and Faber (2010) show that there is not only a clear-cut distinction between metaphors based on motionless images (involving the static physical attributes of entities, such as colour, shape or size, as in “sea *lettuce*” and “*whale shark*”), but also between metaphors grounded in dynamic structure (i.e., function and motion-induced behaviour, as in “*hermit crab*”). They find that there are also metaphors that remain in a transitional area between behaviour and purely physical features, thus sharing aspects from both dimensions.

For instance, the comparison between the source and target in the metaphorical term *anglerfish* arises not only from behaviour (dynamic structure referring to the way the fish lures its prey and pulls at its fleshy, fishing line-like protuberance on its head), but also from physical resemblance of this protuberance to the fishing line (static features). Another example is the term

“boxer crab” (species *Lybia Tesellatta*) (Ureña and Faber 2010, 9). This crab resembles a boxer inasmuch as it uses anemones attached to its claws (comparison in shape and function) to defend itself against octopuses in the same way as a boxer uses his fists to punch his opponent (comparison in behaviour).

Ureña (2011) as well as Ureña and Faber (2010) use the umbrella term *resemblance metaphors* to encompass all metaphor types that involve a comparison in shape, and/or size, and/or colour and/or behaviour. They use the term *non-resemblance metaphors* for those figurative compositions that put abstract patterns into play, along the lines of Lakoff and Johnson’s (1980) structural metaphors. Based on a marine biology corpus analysis, Ureña (2011) formulates standard multiple-correspondence non-resemblance metaphors. A case in point is SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS, which could also be formulated as SEA ACTIVITY IS BUSINESS for short. This metaphor underlies many metaphorical uses, such as “energetic *cost* (of biochemical processes)”, “*expensive* (copulation) investment”, “(high nutrient) *pay-off*”, “(benthic food) *budget*”, “(the epifauna) *capitalises on* (local diversity)”, “*net* photosynthesis”, and “*consumer* organism”.

In comparing the two metaphor categories, however, Ureña and Faber (2010) also conclude that the dichotomy *resemblance metaphor vs. conceptual metaphor* is oversimplistic since being conceptual in nature, resemblance metaphors can also activate multiple cross-domain mappings of rich knowledge and productive inferential structure, features initially attributed to structural metaphors (Lakoff and Turner 1989, 91). The reason for this is the nature of mental imagery, which is an integral part of every stage of metaphor formation (Ureña and Faber 2010, 143).

For example, marine biology resemblance metaphor terms such as “*surgeonfish*”, “*anglerfish*”, “*pilotfish*”, “Spanish *dancer*” (a nudibranch/sea slug species) and “*inn-keeper* worm” can be abstracted into the conceptual metaphor SEA ORGANISMS ARE JOB HOLDERS. This conceptual metaphor further licenses linguistic expressions used by experts to designate marine biology concepts, which are closely related to the abovementioned sea animals. As Ureña and Faber (2010, 137) argue, these linguistic expressions may emerge either from sheer physical resemblance (appearance) or from comparison in behaviour — kinetic structure that can be considered to be working as a more abstract *tertium comparationis*. Accordingly, surgeonfish have “scalpels” (term referring to sharp erectile spines near the base of these animals’ tail), which are used for scaring potential predators away or tearing their skin if attacked; anglerfish use their fleshy

“baits” as a lure to catch prey; harvestfish “harvest” food for survival; pilotfish “cruise” long distances tagged alongside sharks in a mutualistic relationship; Spanish dancer nudibranchs undulate their “ribbons” (term used by biologists to designate sea-slug mantle spirals) to swim forward and backwards across the sea water; and the burrow of inn-keeper worms is occupied by several “commensals”.

The claim that resemblance and non-resemblance metaphors cannot always be classified as separate categories also finds support in general-language metaphor research (e.g., Deignan 2007) and as well as in architecture (Caballero 2006). In her corpus-based study of the conceptual and rhetorical roles of metaphorical, fictive-motion verbs⁴ used by architects to assess design solutions in building reviews, Caballero (2006) suggests a body of conceptual metaphors which reveal their highly imagistic nature while also being conceptually complex. For example, Caballero (2006, 122) finds MALLEABILITY to be a recurrent schema licensing metaphoric thought in architectural structure description. This schema conceptualises and characterises buildings and parts of them as pliable (“fold”, “unfold”), soluble (“melt”) or flexible solids (“stretch”, “splay”, “spread”, “flex”, “embrace”). An illustrative corpus example is the sentence “Large departments *embrace* two atria and each atrium can be enlarged to form *nodes* (Caballero 2006, 153).

These metaphors are imagistic and are thus grounded in physical resemblance because the form that they evoke matches the actual shape of the entities described. This comparison is ultimately based on how the entities are visually scanned by virtue of what Caballero (2006, 3) calls *the expert’s visual thinking*. At the same time, these metaphors can all be regarded as instantiations of the more general metaphor FORM IS MOTION, formulated by Lakoff and Turner (1989, 142–144) to account for a wide array of metaphorical expressions that convey fictive motion in everyday communication (e.g., “The path *stretches along* the shore of the lake” and “The fence *dips* and *rises* in parallel with the terrain”).

It can thus be concluded that underlying metaphoric thought captured by terms of specialised language (e.g., marine biology and architecture) there is a harmonious interaction between the conceptual and the purely perceptual attributes of the entities under comparison.

⁴ These are motion verbs used to describe spatial configurations which do not involve actual motion or change. Talmy (1996, 211), the first scholar to address fictive motion, defines it as “linguistic instances that depict motion with no physical occurrence”. More specifically, fictive motion is simulated motion arising from our visual scanning mechanisms (Talmy 2000; Matlock 2004).

2.4. Socio-cultural and contrastive aspects of terminological metaphor

There is broad agreement among cognitive linguists that metaphorical thought is the result of an inescapable combination of “nature and nurture” (Sinha 1999). This assumption was firstly acknowledged in ordinary language. Because they were shown to essentially determine the shared biology and bodily experiences that give rise to metaphorical thought, socio-cultural factors underlying figurative reasoning eventually received richly deserved attention as from the beginning of the 21st century (cf. Kövecses 2002, 2005, 2015; Dirven et al. 2008; Rohrer 2006; Sinha 1999; Zinken, Hellsten, and Nerlich 2003, *inter alia*).

For example, the non-universal (culturally restricted) metaphorical conceptualisation of emotions such as ANGER, LOVE, and HAPPINESS has been discussed from a cross-cultural perspective (see Kövecses 2005 for a contrastive study of English, Spanish, Bulgarian and Chinese lexical units; Yu 2008 for an English-Chinese comparative analysis of metaphor, body and culture). Socio-cultural factors constraining metaphor-induced conceptualisations of reality give rise to cross-linguistic differences in everyday discourse. In fact, “there can be differences in the range of conceptual metaphors (or, more precisely, the range of source domains) that languages and cultures have available for the conceptualisation of particular target domains” (Kövecses 2005, 70). Most importantly, scholars have eventually concurred that a comprehensive, well-balanced view of metaphor calls for a *joint* intervention and analysis of the “situational, discourse, bodily, and conceptual-cognitive contexts in which cognition is not only embodied but also grounded in multiple ways” (Kövecses 2015, xii).

As with ordinary language research, there are cognitively oriented studies that account for the socio-cultural factors impinging on specialised concept formation through metaphoric thinking. Temmerman’s (e.g., 2000, 2002, 2008) Sociocognitive Theory of Terminology is the first one to emphasize conceptual organisation from a cognitive-linguistic perspective with a view to describing the intrinsically polysemic and variable nature of the terminology of specialised knowledge domains. In fact, Temmerman argues for the interdisciplinarity of terms, thus rejecting the assumption in the General Theory of Terminology (Wüster 1979b) that a term should only belong to one knowledge field.

Temmerman’s proposal is especially inspirational to cognitivist studies of terminological metaphor because it explores the influence of sociocultural situatedness on metaphorization, resulting in extensive terminological metaphor usage in the specialised discourses of genetics and

biotechnology. Much along the lines of Boyd (1993) in the philosophy of science, Temmerman claims that metaphorical thinking is a salient type of thought in science which is essential for scientific advance. As she highlights, “life specialists understand by means of metaphorical domains and [...] these metaphorical domains have left their traces in language as lexeme metaphors (Temmerman 2000, 180). Temmerman (2008) illustrates the flexible nature of metaphor and the role of category prototypicality and extension as a functional tool to fulfil scientists’ needs for linguistic economy and scientific term creation. She supports this claim through the historical, diachronic, semantic and discourse analysis of the polysemous term “splicing”, which started out as a non-terminological word (e.g., “rope splicing”, “film splicing”) and has now become part of the specialised terminology of genetics (e.g., “gene splicing”, “mRNA splicing”).

In relation to the inter- and cross-linguistic studies of terminology, Alexiev (2005, 38) claims that “the choice of a target language conceptualisation strategy and the corresponding surface realisation depend both on cognitive and language- and culture-specific factors”. In his cross-linguistic study of Bulgarian, English and Spanish terms in the fields of mining, geology and civil engineering, Alexiev (2005, 108–115) establishes a set of cultural-experiential parameters that determine the choice of the designation and general concept to be exploited in the terminological metaphorization process. On the basis of data from marine biology, Ureña and Tercedor (2011) refine Alexiev’s classification to offer a typology that sheds light on the relationship between the physical and the sociocultural underpinnings of terminological resemblance metaphor. Specifically, Ureña and Tercedor’s (2011, 216) research builds upon two major claims: (i) sensorimotor perception and sociocultural factors merge into a physical-social experience that shapes scientific knowledge through metaphor; and (ii) the sociocognitive patterns involved in terminological metaphor formation give rise to inter-linguistic variation and commonalities.

After comparing English-Spanish term pairs, Ureña and Tercedor (2011) propose a typology of terminological metaphors based on their level of sociocognitive situatedness. The vast majority of these metaphors are of the resemblance type since they involve the physical comparison of the source and target (similar superficial appearance). Specifically, there are (i) culture-specific metaphors, which are further divided into three subgroups (see Ureña and Tercedor 2011, 223); (ii) culture-typical metaphors; (iii) metaphors arising from unconstrained

angles of referent perception; and (iv) metaphors showing varying degrees of specificity. Hard-core instances of culture-specific metaphor in marine biology exhibit culturally unique source domains in one of the two languages under comparison.

A case in point is the Spanish term “cangrejo *moro*” [literally “*Moorish* crab”], where the dark skin colour of a *moro* (a term exclusively used by Spaniards in the VIII century to designate Muslims who had invaded and settled in Spain at that time) is compared with the darkened exoskeleton of this crab species. The English-language equivalent is “sally *lightfoot* crab”, a metonymic and metaphorical term whose figurative nature is not culturally motivated. The metaphor is found in “foot”, a word literally denoting the lowest part of a human’s leg, which is used to refer to a crab’s walking leg⁵. This metaphor is thus based on a part-for-whole metonymy, where the part (FOOT) stands for the whole (LEG). The noun “sally” and the adjective “light” refer to the physical ability of this crab species to rush out of rock cracks and holes in order to very quickly escape predators or chase prey.

Culture-typical metaphors feature concepts that are characteristic of a community of speakers. For example, the term “*cookie-cutter* shark” arises from the comparison between the cookie-shaped plugs of flesh extracted by the shark from its prey and the actual shape rendered by a cookie-cutter on cookie dough. As is widely known, cookie-cutters are popular baking utensils in the English world (typically in American pastry-making). In contrast, the Spanish-language equivalent used by marine biologists is “*tiburón cigarro*” [“*cigarette* shark”] because of its thin, elongated shape and the dark, collar-like mark around the base of its head, which resembles the tip of a cigarette (Ureña and Tercedor 2011, 226–227). Cigarettes can be found all over the world, so they cannot be labelled as culture-typical, much less as culture-specific⁶.

Demaecker (2017) analyses the linguistic and conceptual nature of corpus-retrieved wine-tasting metaphorical terms from an English-French interlinguistic perspective. She does so with a view to building translation-oriented dictionaries and providing specialised language translators and terminologists with useful tools to carry out their work. Demaecker (2017) demonstrates that wine-tasting conceptual metaphors can be analysed and characterised by means of conceptual integration — that is, through blending mechanisms. In comparing linguistic expressions in the

⁵ A crab has three major limb types: walking legs, swimming legs and chelipeds, which include claws and pincers.

⁶ Due to space restrictions, only the first two metaphor types in Ureña and Tercedor’s (2011) classification are briefly discussed in this paper. See these authors’ article for a full account of all metaphor categories in their typology.

languages under analysis, in this case, English and French, the two languages may rely on the same conceptual metaphor, but sometimes the metaphoric equivalents do not perfectly correspond. By way of example, Figure 1 shows the integrated schema of the English and French lexical items “enclosing” and “s’appuyant sur”, which can be subsumed under the metaphor THE TASTE OF WINE IS A CONSTRUCTION.

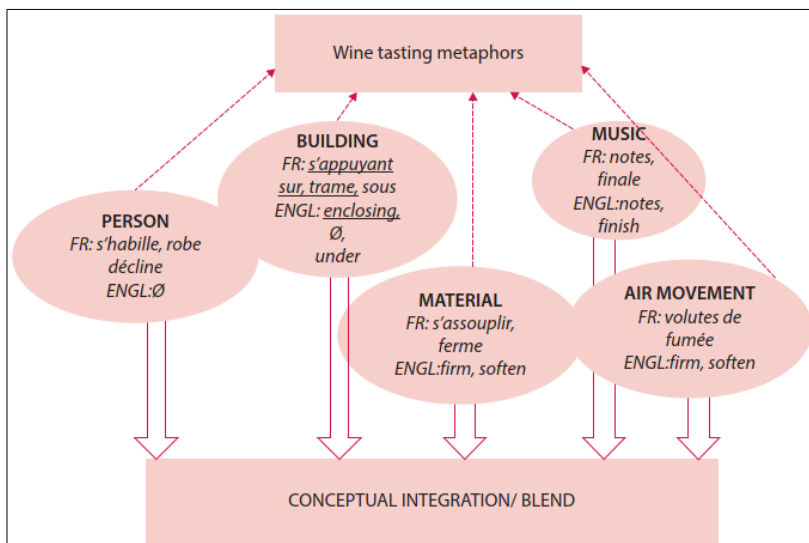


Figure 1. Linguistic expressions of the source domains in a conceptual blending structure, which describes the wine-tasting metaphors “s’appuyant sur” and “enclosing” (Demaecker 2017, 127)

Differences in concept construal through metaphor have also been documented in specialised language discourse from an *intralinguistic* perspective. Ureña and Faber (2014) compare resemblance metaphor terms designating sea organisms that were semi-automatically retrieved from a subcorpus of Spanish-language marine biology research articles. These articles were written by marine biologists in a wide range of Spanish language varieties, including those occurring in Latin-American countries and in Spain (European/Peninsular Spanish). The analysis of this authentic data revealed interesting cases of language-internal terminological diversity not only across the two continents but also within one same country. An example of inter-continental variation is the pair “delfín nariz de *botella*” [*bottlenose* dolphin] – “delfín *mular*” [*mule* dolphin]. Both terminological units refer to the dolphin species *Tursiops truncatus*. However, the metaphorical term “delfín nariz de *botella*” is chiefly used by Latin American biologists. The metaphor is based on resemblance in shape between this animal’s snout, which is particularly short and stubby, and a bottle. In contrast, the corpus data demonstrates that Spanish biologists prefer to

use the metaphorical term “delfín *mular*” because of this animal’s robust appearance as well as its energetic and hardy nature, which is reminiscent of that of a mule (Ureña and Faber 2014, 205).

Geographical fragmentation is thus shown to reflect differing sociocultural models even in one single language. These different models have a direct bearing on the conceptualisation and denomination of entities, attributes, processes, and events in specialised knowledge fields, as is the case of marine biology. Hence the emergence of intra-linguistic denominative variation in science.

4. Conclusions

This chapter has offered an overview of the emergence and development of conceptual metaphor from the perspective of Cognitive Linguistics both in general language and in the terminology of specialised knowledge domains. By disabling wrong assumptions from past theories of language, Cognitive Linguistics provides empirical evidence that metaphorical thought is central to reasoning and, as a result, pervasive and ubiquitous in all spheres of human communication. Ever since the advent of this linguistics framework in the late 1970s, conceptual metaphor has been analysed and described at all levels of verbal description.

Terminologists have studied metaphorical terms and made ground-breaking contributions to the understanding of conceptual metaphor by applying it to specialised language. Importantly, terminological metaphor researchers have refined some of the metaphor types first suggested by general language metaphor scholars. For instance, apart from the two classical kinds of resemblance metaphor, behaviour-based and image metaphors, Ureña and Faber (2010) study marine biology terms to show that there are resemblance metaphors remaining in a translational zone between the two mentioned above, thus sharing aspects of both. In architecture, Caballero (2006) provides corpus-based evidence that image metaphors can exhibit conceptual structure, just as much as conventional conceptual metaphors.

Boyd’s (1993) classification of metaphors in science shows that metaphorical terms are essential to create and further scientific and technological knowledge, whereas exegetical (i.e., novel) metaphors are exclusively used to explain specialised concepts to laymen. However, in identifying the different roles and functions of figurative thought in the domain-specific discourses of genetics and marine biology, Knudsen (2005) and Ureña (2016) refute Boyd’s (1993) monolithic division between purely terminological and novel/deliberate metaphors. These scholars

demonstrate that totally spontaneous and unconventional metaphors are frequent in expert-to-expert communication, not only to humorously describe specialised concepts, but also to conceptually and linguistically structure full scientific units of discourse and advance science and technology. Therefore, challenging previous theory, terminologists have shown that subject-oriented, expert-to-expert communicative contexts are fraught with novel metaphors, which are exploited by specialists for conceptual, textual, and rhetorical (attention-grabbing, imagination-stimulating, and evaluative) purposes.

Terminological metaphor research is also of great use to Cognitive Linguistics because it shows that the embodied (conceptual, cognitive, and bodily) underpinnings of metaphor are indissolubly linked to underlying sociocultural factors. These factors dramatically constrain the conceptualisation and linguistic realisation of entities, attributes, processes, and events in specialised knowledge domains. The merging of physical and social experiences involved in terminological metaphor formation gives rise to inter- and intralingual variation. For this reason, there are studies that provide typologies of terminological metaphors based on their level of sociocognitive situatedness.

Notwithstanding, terminological metaphor research still has much left to discover. One future challenge is to accommodate current burgeoning conceptual metaphor research from a Cognitive Semiotics perspective into terminology studies. This line of investigation outside Cognitive Linguistics, known as *Motivation and Sedimentation Model* (MSM), builds on ideas from classic thinkers, from Aristotle to Merleau-Ponty. MSM argues that metaphors should continue to be treated primarily as signs and sign processes, both from a mono- and multilingual perspective, and that the key point is to distinguish between motivation, convention and situated use, all of which are necessary in order to make sense of the complex dynamics of metaphor (Zlatev, Jacobsson and Paju, in press). MSM has as yet only been applied to metaphor in ordinary language (Devylder and Zlatev 2020; Zlatev, Blomberg and Magnusson 2012; Zlatev, Jacobsson and Paju, in press). There is thus an extensive testing ground for its implementation in the terminology of domain-specific and subject-oriented discourses. Studies in this direction show great promise and will doubtlessly obtain valuable insights into the nature of terminological metaphor.