

Novel Metaphor and Scientific Discourse Come to Terms: A Case Study of Metaphorical Prototerms in Biology

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Abstract

Novel metaphorical expressions have been understudied in traditional approaches to terminology because they normally behave as sporadic units incapable of structuring whole discourse events. To show that this is not always the case, this paper presents a case study of novel BIOECONOMICS metaphors in an academic marine biology research article (Landa 1998). They were analysed following two paradigms: (i) the Career of Metaphor Theory (Bowdle and Gentner 2005), a solid framework for the description of novel metaphor in usage; and (ii) the text-linguistics approach to term description (Collet 2004), which suggests a set of criteria for term definition that challenges the prescriptive tenets of monolithic terminology models. The analysis of unexpected metaphors and similes identified in the text suggests that these units should be regarded as proto-terms experienced as deliberate rhetorical *and* conceptual devices. On a pragmatic level, the metaphors are shown to be part and parcel of the writer's discursive strategy to communicate specialised knowledge to her peers and further science. On a conceptual level, the metaphors are found to be essential building blocks and structuring elements of the mental model of the article.

1 Introduction

The Career of Metaphor Theory (CaMT)¹ (e.g. Bowdle Gentner, 2005) is one of the most representative models of metaphor description within the cognitive linguistics strand (cf. e.g. Steen 2007 for a detailed account of the rest of the models). Bowdle and Gentner examine metaphor in usage, looking at both spontaneous and conventionalised instances of metaphoric use in

context. This proposal thus provides potential ground for a discourse-led metaphor analysis, becoming a valid framework for this study.

Bowdle and Gentner claim that novel metaphors are processed by comparison, i.e. alignments between target and base concepts; in contrast, conventionalised metaphors are processed by categorisation, where comprehension of the metaphor “requires that one use the base concept to elicit a metaphoric category that it typifies” (Bowdle and Gentner, 2005: 194). CaMT further posits that whether metaphors are processed directly (i.e. as stable metaphoric categories) or indirectly (as comparisons) will depend both on their degree of conventionality and on their linguistic form (Bowdle and Gentner, 2005: 193). This study focuses on the behaviour of novel metaphors in a marine biology research article. Many novel metaphorical expressions in this article are thus suggested not to be processed directly as well-entrenched categories with stable linguistic forms, but indirectly as innovative *comparisons* formalised as unconventional linguistic pairings. Being indirectly comprehended, these comparisons involve a complex sequential process whereby the intended metaphoric meaning is derived by the expert reader only when the pre-existing literal (or conventionalised figurative) meaning of the base term cannot be sensibly applied in the biology discourse.

This assumption is reinforced by the evident rhetorical function of each of the linguistic forms instantiating the novel metaphors brought by the writer into the marine biology article, not inviting but rather making the reader constantly map the source domain onto the target domain for

¹ The most reasonable acronym to use here would be CMT. However, this could be confusing for metaphor scholars in

that Conceptual Metaphor Theory is often abbreviated as CMT.

specialised knowledge comprehension. The analysis of these linguistic forms is relevant to CaMT insofar as this model has traditionally left aside the role of the rhetorical form in which a metaphor is expressed (Steen 2007: 78).

Another reason to use CaMT in this study is that there is authoritative research within or in consonance with this theory that claims for the existence of deliberate metaphor (e.g. Steen, 2009; Krennmayr, Bowdle, Mulder and Steen, 2014). This research provides evidence that sometimes language users pay *attention* to their use of metaphor for making cross-domain comparisons (Steen, 2009: 180). As Steen (ibid.) goes on to note, this normally takes place in the deliberate metaphorical design of texts and discourse units. As will be shown, this is precisely the scenario that is set up in the marine biology research paper analysed in this study.

Applying CaMT to the analysis of figurative expressions in expert-to-expert scientific communication should also help demonstrate that the stability preserved by canonical metaphorical terms — i.e. widely acknowledged instantiations of fixed linguistic regularities carrying specialised meaning — may be positively altered by the introduction of novel metaphors capable of conceptually articulating a domain-specific text/discourse event. The novel metaphors examined in this study are thus evidence of the ignored eclectic nature of specialised discourse, which can also produce highly creative metaphorical expressions that critically assist in introducing innovative knowledge and illustrating scientific findings for theory construction.

In CaMT, variation of linguistic form also involves similes. According to the *principle of grammatical concordance*, similes, which are grammatically identical to literal expressions of comparison, should invite explicit (albeit metaphorical) comparisons between target and base domains (Krennmayr et al., 2014: 70). Krennmayr et al. (2014) also suggest that the signalling effect of similes helps integrate a metaphoric frame into people's mental representation of a text. The research article analysed in this study contains a number of similes that are shown to form a part of the writer's argumentation strategy to present and describe specialised knowledge to the specialist readership. These similes are thus useful because of their explicit interpretative guidance, anticipating the analogy to the expert reader by effectively establishing and explicitly signalling metaphoric comparisons between two concepts.

As with novel metaphors, certain similes used in the marine biology domain are also expected to aid integration of a metaphoric schema into experts' mental text representation and comprehension. Bowdle and Gentner (2005: 211) note, novel similes and metaphors involve novel base terms that refer only to *domain-specific* concepts [my emphasis].

Collet's (2004) approach to term description combines text-linguistic and Language for Specific Purposes assumptions. This proposal draws from earlier theory on context-oriented terminology (e.g. Bourigault and Slodzian, 1999), and departs from prescriptive paradigms — especially, Wüster's (1979) General Theory of Terminology, which argues for monolithic, decontextualised specialised meaning description. Collet's model is interesting because it suggests a new definition of term, based on a set of requirements that a lexical unit needs to meet to be considered a terminological unit. This analytic method is instrumental to the characterisation of the metaphorical units examined in the present study.

The first requirement involves placing the focus of analysis beyond the level of the sentence, considering the text the best-suitable instrument for term definition and description (Collet 2004: 103). Secondly, a subject-oriented text is regarded as the product of a communicative act or event where the lexical items used by an expert take on particular and specific meaning to produce and communicate specialised knowledge. Thirdly, for the sake of text *coherence*, a writer adjusts the meaning content of a term that he uses to his understanding of the realities that it refers to (Collet, 2004: 109). This way, terms help the writer achieve texture. Fourthly, to achieve *cohesion*, terms tend to vary their linear structures in specialised language texts, exhibiting a range of different lexical-syntactic configurations that make up a *paradigm*. A paradigm is a closed set composed of the full-length of the term and all of its alternate shorter forms (Collet 2004: 108).

Albeit novel and unconventional to the knowledge field of biology, the figurative expressions extracted from the research article examined in this paper (see section 4) are shown to be *semantically charged linear structures* (Collect, *ibid.*), which designate abstract or concrete realities studied in the special-subject text where these metaphorical expressions occur. Thus, we can speak of specific entity-word pairings/correlates that are exclusively created and

activated through metaphor in a concrete *text* belonging to a particular specialised knowledge domain. As will be shown, a good number of newly created metaphors retrieved from the research study examined are realised in a variety of alternate linguistic forms that make up paradigms or full linear structures within the texts where they occur. Like well-entrenched terms, these arrays of alternate metaphorical forms build *coreferential chains* (Collet, 2004), which typically contribute to text cohesion in domain-specific writing. This phenomenon has also been documented by other authors advocating for a text-linguistic approach to terminology, such as Rogers (2007), who speaks of *lexical chains*.

For all reasons given above, the novel biology metaphors analysed in this research can be regarded as *proto-terms*, i.e. lexical items that exhibit the same conceptual and lexical-syntactic features as terms but still need to be systematically used across specialised research articles and books.

The usefulness of similes from a text-linguistic approach in terminology studies resides in the intrinsic conceptual and linguistic characteristics of these figures of thought. As earlier explained, a text-linguistic analysis of specialised meaning goes beyond the scope of the sentence to focus on longer contextualised linguistic units, which effectively contribute to text construction as cohesion- and coherence-producing agents (Collet, 2004). Linking this claim to CaMT's consideration of similes as instruments aiding integration of metaphoric schemas in text representation and understanding, it can be argued that the use of novel metaphor base structures longer than single words and simple phrases easily reflect the conceptual processes of scientific communication. Concretely, similes participate in the description of expert knowledge where newly created comparisons are established. In doing so, similes show their conceptual potential as rhetorical devices, capturing the mind's eye, and creating highly imagistic representations of *entire* research articles.

2 Case study

2.1 Data

The analysis of novel bioeconomics metaphors conducted in this paper reports on empirical data extracted from economist Landa's (1998) research study, which was published in the academic

journal *Environmental Biology of Fishes* (see full details in References). The analysis illustrates how a scholar manages to deliberately exploit a set of innovative metaphors with a view to conceptually and linguistically scaffolding her train of thought throughout a specific scientific discourse event. Fine textual analysis of a single text through bulk data retrieval has already been successfully performed by previous terminology studies (cf. Pecman 2014 for terminological variation and cognition).

Despite concentrating on novel metaphors found in one single text, the present research also draws upon a compilation of marine biology articles published in high-impact academic journals in order to test the authentic novelty of creative metaphor candidates against such articles. The dataset consists of 1,938,472 tokens/words. Table 1 includes the name of the journals as well as numerical information about them. The corpus articles were searched with the search option of *Wordsmith Tools*[®] — a lexical analysis software programme — for novel metaphor candidates. If hits of these candidates were obtained, they were then not classified as novel metaphors.

Journals	Number of Articles	Number of Tokens
Marine Biology	32	286,736
Environmental Biology of Fishes	31	266,065
Phycologia	30	244,758
Hydrobiologia	30	235,477
Journal of Experimental Marine Biology and Ecology	22	172,441
Journal of Fish Biology	18	126,570
Fish Physiology and Biochemistry	17	108,960
Ecotoxicology	17	106,929
Coral Reefs	16	102,830
Symbiosis	15	119,346
Biosemiotics	13	108,041
NATO Advanced Study Institutes Series	8	60,319
	Total: 249	Total: 1,938,472

Table 1: Academic journal articles in the corpus.

2.2 Data processing

Identification of novel metaphor and simile candidates

As shown by contexts (1) and (2), newly created metaphors and similes normally appear between inverted commas or in italics in the biology text corpus. This was attested by browsing the corpus through the search option of *Wordsmith Tools*[®].

- (1) The choroid *rete mirabile* is a large **horseshoe-shaped, gland-like** structure located around the optic nerve in the choroid layer of the eye of many species of fishes (*Nato Advanced Study Institutes Series 1*, 1975).
- (2) In recent years the fruit fly, *Drosophila melanogaster* has become the “come-back kid” in biology, though some might question whether research on this model animal ever peaked. The initial interest in the fruit fly goes to the days of Thomas Hunt Morgan and his infamous “fly room”, the **ground zero** of the genetics movement. Today the focus on the “**black box**” (*Biosemiotics* 2009, 2:181-191)

Searching a corpus for inverted commas is normally a strategy of great use not only in general language studies of metaphor, but also in the analysis of newspaper articles and popular science publications (Goatly, 2002: 73). Even though their efficiency in specialised discourse had hardly been tested, inverted commas and italics were found to frequently act as visual direct and indirect metaphor markers to the specialist readers, signalling the unexpected surprise effect that spontaneous metaphors cause in them for not being conventionalised units in the field. The conclusion drawn is that scholars writing their research articles are generally aware that novel metaphorical units should be marked somehow to indicate that they are uncommon expressions, alien to the biology discourse. Based on this, the first strategy devised to identify novel metaphor candidates was to search the entire corpus for inverted commas, and next, focus the search on Landa’s article. The markers “” and “” turned out to be extremely productive cues for potentially novel metaphors. Words in italics were also examined, also pointing to a number of linguistic candidates.

Testing and analysing novel metaphor candidates

Linguistically speaking, a metaphorical expression requires the identification of some kind of semantic tension or incongruity between its basic sense and that sense activated in a particular communicative situation. A valid strategy to find instances of metaphoric usage from a discourse-led perspective (cf. e.g. Cameron, 2007: 118) relies on two criteria: (i) the presence of a lexical item (the vehicle or base) that has a meaning that can be said to contrast with its meaning in the discourse context; (ii) the potential for extra meaning to be produced as a result of bringing together the vehicle’s standard or de-contextualised meaning and its meaning activated in a specific discourse event. Based on these criteria, most of the lexical items that appear between inverted commas or in italics in Landa’s article were found to have a metaphorical meaning.

In many passages of her article Landa creates totally innovative metaphors in the form of quasi-terminological items or proto-terms, exhibiting a linguistic arrangement that differs from that of well-entrenched terminological metaphors in bioeconomics — a well-entrenched field of inquiry that includes a considerable number of well-established terminological metaphors (see below). For instance, she sets a comparison between *vote-with-the-feet* (base concept) and *vote-with-the-fins* (target concept), the latter being a new co-occurrence of lexical items. Even with single-word metaphorical expressions from the source domain, such as *club*, Landa comes up with alternate linguistic forms to figuratively refer to marine biology entities and phenomena. For instance, she suggests the novel metaphor phrases *informal club* and *multi-product club* to describe fish schools with particular behavioural patterns.

Those metaphorical expressions in the analysed article that preserve the linguistic forms displayed in the base domain are also considered to be novel because they still entail newly created comparisons between two (not three) concepts in alignment (not categorisation). At the conceptual level, this can be explained by recourse to *extended mappings* between the base and target domains, a notion suggested by Bowdle and Gentner (2005: 212) in CaMT (see continuous arrows in Figure 1 and explanation below). As these authors put it, to the extent that concepts are often understood at least partly in terms of relations to other concepts within a particular knowledge domain, metaphoric mappings can be

expected to extend beyond the named target and base concepts to more global conceptual systems. As the text corpus demonstrates, economics is a field of expertise that has historically and systematically been exploited by biologists, giving rise to a large number of highly recurrent, well-established terminological metaphors, such as *capitalise on*, *economise on*, and *energy cost*, in the biology domain. For this reason, we can speak of a subfield known as *bioeconomics*. Conceptually speaking, and following CaMT (Bowdle and Gentner 2005: 209), the conventionalised mappings operating between pairs of concepts from the base (ECONOMICS) to the target (BIOLOGY) domain have ultimately been overridden by single mappings, which exclusively direct the target concepts from superordinate concepts that make up upper-level metaphoric categories. For this reason, these metaphors are argued to be processed directly. Figure 1 illustrates this re-arrangement in a concept-structure schema.

As Landa (1998: 355) explains, the theory of clubs and the theory of public goods form a part of the public choice theory within ECONOMICS, containing conventional metaphorical terms, such as *free rider* (somebody who gives up on an established economic paradigm to live by their own principles), *Pareto-optimal* (referring to a financial situation where one person is made better off and no one is made worse off), and *club good* (benefit obtained when belonging to a particular economic force). Figure 1 shows how these ECONOMICS concepts are projected onto the BIOECONOMICS domain, prompting *novel* cross-domain mappings that involve horizontal alignments of *two* (not three) concepts (see contexts in *Analysis and Discussion of Empirical Data*, which provide textual evidence of these systematic comparisons). For this reason, these metaphors are argued to be processed *indirectly*. As a result of these metaphoric mappings, *free rider*, *Pareto-optimal*, and *club good* are made to designate domain-specific entity-word correlates carrying particular specialised meanings in a concrete communicative act within the marine biology discourse.

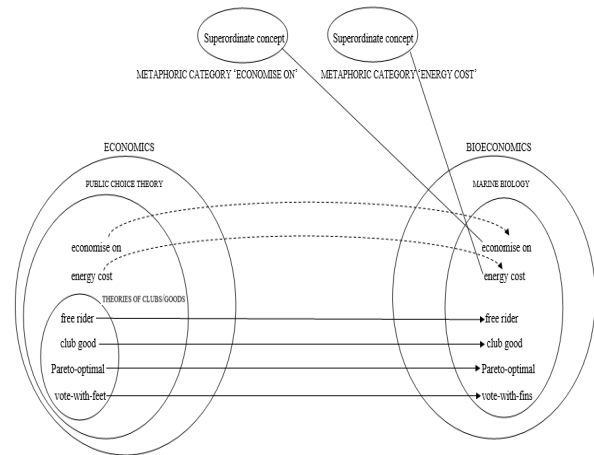


Figure 1: Overridden conventional (discontinuous arrows) and novel (continuous arrows) cross-domain mappings between ECONOMICS and BIOECONOMICS in Landa’s article. Conventional mappings give way to metaphoric categories.

These newly created metaphors arise from extended (novel) mappings between the economics base domain PUBLIC CHOICE THEORY (concretely, the subdomains THEORIES OF CLUBS AND PUBLIC GOODS), which includes conventionalised metaphors, and the target subdomain MARINE BIOLOGY. Integrating the rest of innovative comparisons (the most representative ones are discussed in section 4) into this target subdomain resulted in an entire network of interrelated novel metaphors that conceptually and linguistically vertebrate Landa’s discourse.

3 Results and Discussion

Identifying metaphor candidates, testing them, tracking metaphors across corpus texts and grouping them are the four core processes in every method of metaphor-led discourse analysis. Having gone through all four stages, the next step in this study was to analyse and describe the novel metaphors and similes recruited as contextualised linguistic units in Landa’s article. This was done with a view to providing empirical evidence of the following claims:

- (i) the novel marine biology metaphors examined are deliberately and systematically exploited by Landa with an evident rhetorical purpose, which is to bring the expert readers’ attention to the contents of the article, overtly encouraging them to constantly map the ECONOMICS base domain onto the

- BIOECONOMICS target domain for integrated specialised knowledge comprehension;
- (ii) in connection with the last idea in (i), the role of the novel metaphors and similes is also to conceptually and linguistically articulate the author’s paper to communicate scientific knowledge;
- (iii) the novel metaphors conform to Collet’s (2004) criteria, which allow these metaphors to be considered as proto-terms or terminological units in the making.

As explained earlier, in her article Landa deliberately makes sustained comparisons between theories of clubs and public goods in economics, which are conventionalised conceptual metaphor themselves, and fish schooling behaviour. Such comparisons instantiated as novel metaphors and similes in the text. The first piece of empirical evidence showing that they really are recurrent creative metaphors that systematically occur throughout the entire article is their high frequency of appearance. Table 2 includes the number of linguistic occurrences of the novel BIOECONOMICS metaphors identified in the article². These metaphors are presented as lexemes and as the diverse linguistic forms (tokens) that they take on in the text.

Lexemes	Tokens (number of occurrences)
Free rider	free rider(s) (8); free riding (2); free-riding (2); free ride (4); free rides (1); quasi-free rider(s) (5); quasi-free riding (1)
Club	club (42); exclusive club (4); self-enforcing exclusive club (3); informal club (2); multi-product club (3); size club (2); mixed club

² This table does not include novel similes because they involve relatively long stretches of text, not just single or multiword lexical units, as is the case for novel metaphors. Examples of similes are discussed below in this section.

³ The meaning of *selfish* is understood here from an anthropocentric perspective, thus involving conscious (vs. mechanistic/instinctive) intersubjective aspects, such as

	(1); non-discriminatory club (2)
Club good	club good(s) (24)
Club member	club member(s) (23)
Selfish fish	selfish fish (28)
Invisible fin	invisible fin (1); invisible fin process (1)
To vote with fins	vote-with-their-fins (3); voting-with-its-fins (1)
To lift a finger	lifting a fin(ger) (1)
Pisces economicus	Pisces economicus (1)
Pareto-optimal	Pareto-optimal (2); Pareto-optimality (3)
Inspector	inspectors (2); inspecting behaviour (1)
Caste	caste of guard fish (1); caste such as guard fish (1)
Congestion/crowding	congestion/crowding (1)

Table 2. Lexemes and tokens of novel BIOECONOMICS metaphors in Landa’s article.

Context (3) is the first example containing textual evidence of the sustained comparisons between ECONOMICS and MARINE BIOLOGY in Landa’s article. Conventional metaphors, which were also found in many other corpus texts, are shown in small capitals. The novel and highly unconventional metaphors are shown in bold.

- (3) The prevalence of fish schools seem to point to the schooling fish as a ‘SOCIAL FISH’. But is SCHOOLER a ‘social fish’ or is it really a ‘**selfish fish**’, or what Boulier & Goldfarb (1991) call *Pisces Economicus*, the counterpart to *Homo economicus*, the selfish, calculating or rational economic man of economic literature?

Context (3) includes the novel marine biology metaphor *selfish fish*³ and the highly

desire, beliefs, attentional foci, and intentions. In this sense, *selfish* does have a figurative meaning in Landa’s text since only humans clearly have all of these cognitive and psychological capacities and states (cf. Zlatev, Racine, Sinha and Itkonen 2008). Landa herself makes the distinction clear between humans and fish in terms of cognitive capacities by

unconventional expression *Pisces economicus*, which arise by comparison with two terminological units that have domain-specific meanings in economics: *selfish economic man* and *Homo economicus* (cf. Boulier and Goldfarb, 1991). Landa draws on these two expressions to bring up creative metaphors in biology that enable her to raise questions about the actual behaviour of schooling fish (a well-entrenched terminological metaphor, as shown by the text corpus). In doing so, Landa is constantly establishing inter-textual references between her arguments in marine biology and economic theories (cf. also Buchanan and Tullock's 1962 club theory below). This is thus an evident example of the additional development of the BIOECONOMICS metaphorical frame (by means of extended mappings) through inter-textuality. By combining novel and conventional BIOECONOMICS metaphors, Landa substantially enriches her specialised discourse event, providing an entire expert community with specific explanations about specialised biology concepts. The innovative nature of the novel metaphors that she introduces clearly serves as a powerful rhetorical tool to illustrate and define concepts, and eventually, construct and further science in an attractive manner.

The rhetoric of novel figurative expressions to conceptually structure a whole scientific discourse event also manifests in the form of even more explicit comparisons, such as the simile described in context (4).

- (4) Visual cues and odors of conspecifics provide LOW COST signals for fish of the same species to identify each other, just as ethnicity serves as low cost non-price signal in Landa's (1981) theory of the EHMGM.

Landa (1998: 359) aligns the concept *ethnically homogeneous middle-man group (EHMG)*, proposed by herself in economics, with *fish school* with the help of the simile signal *just as. EHMGM* refers to the idea that middle-men prefer choosing trading partners who are members of their own kinship or ethnic group (e.g. Chinese or Jewish). The clear interplay between the conventional (terminological) metaphor *low cost* and the simile *EHMG-fish conspecifics* is used by

comparing fish with the "calculating and rational economic man" [my emphasis] in context (3).

Landa to explain how (effectively) recognition strategies in fish work. From a CaMT perspective, this interplay is intended to stimulate the imagery of the article's expert readers, who immediately incorporate the novel BIOECONOMICS metaphors and similes in their mental text representation. The effect is an easier understanding of specific marine biology concepts.

Landa uses the economic theory of clubs to set a comparison between a group of people who come together/join forces in order to reap economic benefits (i.e. a club) and fish schools. The novel metaphor *club* arises from this comparison to explain the highly coordinated behaviour of schooling fish to obtain hydrodynamic benefits (see context 5). The theory of clubs is further exploited in context (5), where Landa defines another type of schooling fish, (*quasi-*)*free rider*⁴, and the benefit sought by schooling fish, the *club good*. Again, innovative metaphors (in bold) work together with fully-fledged metaphorical terms (small capitals) to produce specialised knowledge in a discourse event.

- (5) A fish SCHOOL provides a dramatic example of collective action in nature; it is a **club** which confers benefits on its members [...] A **selfish** SCHOOLING fish can reduce its own ENERGETIC COSTS EXPENDED in swimming by positioning itself correctly with respect to those immediately preceding it. The *follower* fish is literally **free riding** on the hydrodynamic benefits (**the club good**) provided by **club members**. But the **selfish** SCHOOLING fish cannot completely **free ride**: the best it can do for itself is to be a '**quasi-free rider**'. This is because in order for each individual **selfish fish** to benefit from the LOWER COSTS that come from CONSUMPTION of the **club good** the individual fish must continually adjust the direction of swimming to stay with the group [...] The move from lone fish to SCHOOLING member, either as a leader or as a follower, is '**Pareto-optimal**', a term economists use to describe a situation in which one person is made better off, no one is made worse off.

As context (5) shows, the metaphors *free riding*, *club good*, *club members*, and *Pareto-optimal*, which are fully-fledged terminological units from the economics field (cf. Buchanan and Tullock's

⁴ In economics, the terminological metaphor *free rider* refers to someone who benefits from resources, goods, or services without paying for the cost of the benefit.

1962 public choice theory), acquire specific and precise novel meaning content to designate realities other than people when inserted in a particular scientific biology text in a specific communicative situation. This fact somehow goes along the lines of Rogers' (2007) (con)text-dependent, heterodox view of terminological meaning and term description, which departs from isolated specialised meaning encapsulated in headwords and term entries in specialist dictionaries and glossaries. According to Rogers (2007: 15), the semantic relation *in text* is one of reference by terms as word forms to what they stand for on particular occasions of their utterance. In other words, reference is an utterance-dependent notion in specialised discourse as well, she concludes. Based on this non-prescriptive consideration of terminological meaning, the novel biology metaphors above do designate specific referents, and thus, can be regarded as proto-terms. They would only need to be conventionalised, i.e. systematically used by experts in their scientific research articles, to gain the status of fully-fledged terms in the marine biology field.

Even though these linguistic units cannot be considered terms in their own right (conventionalised and well-established linguistic items with stable specialised meaning across the full spectrum of publications in a specialised knowledge field), they perform a highly restrained referential function with respect to a highly-constrained specialist domain (biology) in a *particular* scientific discourse event. This is an aspect that is characteristic of terms (Rogers, 2007: 15). Consequently, the novel metaphors in Landa's article have become *semantically charged linear structures* (Collet, 2004: 105), whose restrained referential function brings about specialised meaning content. This meaning content adds to the coherence of this communication act, entitling the novel metaphors to help the writer explain specialised knowledge throughout the entire research article, and eventually, conceptually structure her discourse.

Still another reason to treat the novel metaphors analysed as proto-terms is the linguistic variability that affects some of them. Context (5), and in general, Landa's full text include a range of linguistic forms of different novel metaphors (see Table 2 above for the full array of forms). For instance, the metaphor *free rider*, including the nominal compounds *free rider* and *quasi-free rider*, the deverbal compound *free-riding*, and the

verb forms *free ride* and *free riding*. All these linguistic variants clearly form a cohesive network that ensures, the flow of specialised information, thus critically contributing to text cohesion. This concatenation of linguistic alternates is a counterpart example of what Collet (2004: 99) calls *coreferential chain* for the spectrum of lexical-syntactic variants of a terminological unit that co-occur in a particular specialised text.

Conclusions

Based on empirical data extracted from a marine biology research article (Landa, 1998), this paper shows that novel metaphors and similes, two figures of thought traditionally understudied in specialised language research, can constitute a critical design feature of scholars' meaning-making capacity in scientific discourse. Textual evidence is given that Landa systematically and deliberately exploits a variety of novel metaphors as extended comparisons from the metaphoric BIOECONOMICS domain to describe domain-specific knowledge. From a pragmatic perspective, these metaphors are experienced by the expert readership as unexpected and innovative linguistic units. Specifically, Landa uses them as rhetorical devices in order to catch the specialist reader's attention and stimulate his/her imagery for specialised concept understanding.

The Career of Metaphor Theory (Bowdle and Gentner, 2005) was used as the theoretical and analytic model to identify and describe the novel metaphoric nature of the expressions examined. Contrary to traditional studies following monolithic terminology theory, this research demonstrates that Collet's (2004) text-linguistic approach to term description is valid to account for the conceptual and linguistic features of novel marine biology metaphors. Because they conform to Collet's term definition criteria, novel metaphors carrying specialised meaning in Landa's article should be regarded as proto-terms, awaiting full acknowledgment and wide use in academic publications to become fully-fledged terminological units.

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