

ANNA DROGOSZ

The University of Warmia and Mazury in Olsztyn

Darwin's Metaphors. A Cognitive Semantics Analysis of the Theory of Evolution

Abstract

The objective of the paper is to present a Cognitive Semantics approach to Darwin's theory of evolution. An analysis of the text of *The Origin of Species* allowed to identify a number of conceptual metaphors, such as: EVOLUTIONARY CHANGE IS A JOURNEY, MODIFICATION IS SUBSTANCE, ORGANISMS ARE FAMILY MEMBERS, RELATIONSHIPS AMONG ORGANISMS ARE STRUGGLE, and personification of natural selection. The metaphors are illustrated by excerpts from Darwin's book. It is claimed that conceptual metaphors contribute to coherence of Darwin's argument, help to present the theory in a comprehensive and interesting way, and have impact on evolutionary reasoning due to metaphorical entailments. The analysis provides evidence that the logic of the evolutionary theory derives partially from the logic of source domains through which the fundamental concepts of change and relationships among organisms are conceptualized. Finally, it is argued that evolutionary texts offer a rich source of well-documented materials valuable for diachronic studies of metaphor in scientific discourse, beginning with Darwin's notebooks, through his books, and then over 150 years of evolutionary texts, both scientific and popular, by various authors. It is also believed that a Cognitive Semantics analysis can provide useful insights for better understanding the evolutionary theory as well as controversies around its presentation and reception.

Keywords: Darwin, conceptual metaphor, metaphor in scientific discourse.

Introduction

This paper is part of a larger research applying linguistic perspective to the study of evolutionism and communication related to its presentation and reception. Specifically, it presents results of an analysis of the seminal book by Charles Darwin *On the Origin of Species* from the perspective of the Conceptual

Metaphor Theory. The paper gives an account of conceptual metaphors used by Darwin in framing his theory, discusses their function in evolutionary discourse and considers their possible impact on the main tenets of the theory.

In the first section of the paper, we briefly present the methodology used in the analysis, namely the Conceptual Metaphor Theory. Next, we give a short overview of the assumptions of Darwinism followed by an analysis of selected conceptual metaphors identified in *The Origin*. Finally, we consider in detail the roles that these metaphors play in Darwin's argument.

1. The Conceptual Metaphor Theory

The objective of this paper is to present the potential of the application of the linguistic theory of conceptual metaphor to scientific discourse in general and evolutionism in particular. Since our focus is on evolutionary discourse rather than the nature of metaphor, its creation and processing, we offer only a cursory presentation of the Conceptual Metaphor Theory (CMT) intended to provide background for the subsequent analysis.¹ The foundation of the theory and of our analysis is the notion of the conceptual metaphor defined as “understanding one conceptual domain in terms of another conceptual domain,” with the conceptual domain being “any coherent organization of experience” (Kövecses 2002: 4). Examples of conceptual domains could be LIFE, LOVE, BEING SAD, LIGHT, ECONOMY, WAR and many, many more domains related to our functioning in the physical, social and mental world.

Not only artistic language but also everyday language is rich in conceptual metaphors. Frequently quoted examples include sentences in (1), which instantiate the conceptual metaphor THEORIES ARE BUILDINGS (adapted from Kövecses 2002: 5)²:

- (1)
- a. Is that the foundation for your theory?
 - b. The theory needs more support.
 - c. We need to construct a strong argument for that.
 - d. The theory will stand or fall on the strength of that argument.

In these sentences the conceptual domain of THEORY (a **target domain** in CMT terminology) is described in terms of BUILDING (a **source domain**). An important, though sometimes challenged claim that CMT makes about conceptual metaphors is that they are not just a matter of language but mainly of thought (hence the term “conceptual metaphor”). Thus, sentences in (1) are a result of a projection of our experience with buildings together with the language used to talk about them onto our experience with theories. Such projections, or mappings, or correspondences between source and target domain are systematic and can be neatly listed. Table 1 summarizes the mappings for the metaphor THEORIES ARE BUILDINGS.

1 The introductory texts and outlines of the Conceptual Metaphor Theory include Evans and Green (2006), Kövecses (2002), Lakoff (1993), Lakoff and Johnson (1980) and many others.

2 We conform to the CMT convention of using capital letters for conceptual metaphor labels.

Table 1. Correspondences (mappings) between domains

Source domain (BUILDING)	Target domain (THEORY)
the foundation of a building	the basis of the theory
support	evidence
strength	plausibility
construction	creation
collapse of a building	fall of a theory

Other examples of conceptual metaphors could be ARGUMENT IS WAR in (2), TIME IS MONEY (3) and LIFE IS A JOURNEY (4) (adapted from Kövecses 2002: 5).

(2) ARGUMENT IS WAR

- a. Your claims are indefensible.
- b. He attacked every weak point in my argument.
- c. His criticisms were right on target.
- d. I've never won an argument with him.
- e. If you use that strategy, he'll wipe you out.

(3) TIME IS MONEY

- a. You're wasting my time.
- b. This gadget will save you hours.
- c. How do you spend your time these days?
- d. That flat tire cost me an hour.
- e. You don't use your time profitably.

(4) LIFE IS A JOURNEY

- a. He's without direction in life.
- b. I'm at a crossroads in my life.
- c. She's gone through a lot in life.
- d. He's gone (= died).

At this junction two comments are due. Firstly, a distinction should be made between a metaphor (labelled, for example, LIFE IS A JOURNEY), and metaphorical linguistic expressions, in that case all sentences in (4). Metaphorical linguistic expressions are manifestations of a metaphor in language, while metaphor as such is a cognitive construct.³ This distinction will be crucial in the actual study of Darwin's language, when excerpts of *The Origin* will be quoted as linguistic manifestations of metaphors used to conceptualize the world of nature. The second comment concerns the function of metaphors in language and cognition, and the resulting nature of the relationship between the source and target domain. Recall that conceptual metaphors are used to think and talk about one domain in term of another. Most often it means thinking and talking about a new, abstract or vague domain of experience using a concrete and

3 Recent studies show that metaphors can also be manifested in images (Forceville 2008) and music (Zbikowski 2008).

well-known domain as a reference point. That is why most source domains are concrete, well-known from experience while target domains are vague or abstract.

Metaphors in artistic language have been recognized and studied since antiquity. Cognitive Semantics, and specifically the CMT, have demonstrated that conceptual metaphors underlie everyday communication. This study, in turn, embarks on the investigation of metaphors in scientific discourse. Considering that the role of conceptual metaphor is to facilitate expression of abstract and/or unfamiliar concepts, the presence of conceptual metaphors in language of science is to be expected. Indeed, an extensive body of research on metaphor in science (e.g. Boyd 1993; Brown 2003; Fojt 2009; Knudsen 2003; Kuhn 1993; Soskice, Harré 1995; Zawisławska 2011) demonstrates beyond doubt the importance of figurative language in scientific communication. The scope of this study is on metaphors in one branch of science, that is evolutionism, especially its first full exposition by Charles Darwin.

2. Darwinism: main assumptions

Before we begin our exploration of metaphors in evolutionism, a short presentation of main assumptions of the theory is due. This outline is intended to give a general background for the subsequent linguistic analysis and is intended for linguistics or researchers from the area of the humanities. It may be found insufficient or even inaccurate by specialists in the evolutionary biology and we humbly accept any criticism.

The theory of evolution was fully framed for the first time in 1859. That is the year of the first edition of the book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* by Charles Darwin. The book had several editions within Darwin's lifetime, in which he introduced some additional explanations or modifications to the text. This study is based on the second edition in its 1998 Oxford issue and the page numbers in brackets after the quoted excerpts come from this book.

The main claims of Darwinism can be summarized as follows: firstly, species of organisms are not immutable; instead, they change in time as a result of small modifications within a species accumulated over long periods of time and transferred to subsequent generations. This accumulation of modifications first leads to varieties and later to new species. Secondly, because more offspring are born than can possibly survive, and because the resources of the environment are limited, organisms constantly struggle for survival. Consequently, those organisms that possess valuable modifications are more likely to survive and leave offspring than those that do not possess such features. Thus, new species are not only different but also improved and better adapted to their environment when compared to parent species. Thirdly, evolutionary change can be explained by an operation of natural laws, natural selection being the most important. These laws rather than supernatural intervention account both for diversity of life forms and their amazing adaptation.

In next section, we shall see that while Darwin's argument was undoubtedly based on sound empirical observations and evidence, the scientific model he proposes is presented through a number of powerful conceptual metaphors. Our analysis will attempt to answer the following research questions:

- What conceptual metaphors are used in this model?
- What are the functions of these metaphors in the theory?

- What consequences for the theory these metaphors have?

3. Darwin's metaphors

Before we embark on the quest for Darwin's metaphors, several clarifications have to be made. Firstly, Darwin was aware of the metaphoricity of his description. What is more, his sensitivity to figurative language was astonishing for a non-linguist. On many occasions, especially in later editions of his book, he used the expression "metaphorically" to direct his readers in a non-literal interpretation of the text. Below there are just three quotations:

- (5) I should premise that I use this term [natural selection] in a large and **metaphorical sense**, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny. [53]
- (6) It may **metaphorically** be said that natural selection is daily and hourly scrutinising, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. [70]
- (7) Now, all these modified descendants from a single species are related in blood or descent in the same degree. They may **metaphorically** be called cousins to the same millionth degree, yet they differ widely and in different degrees from each other. [341]

Secondly, Darwin did not overuse metaphors, although the focus of this study may generate a distorted impression that Darwin intentionally adorned his text with a multitude of figures of speech. Just the opposite. A careful reading of the book as well as a comparison with evolutionary writers such as Richard Dawkins indicates that Darwin was very parsimonious with metaphorical language and that most metaphors result from communicative necessity. Thirdly, although metaphors in this study are discussed individually, in the original text they are interconnected, they support one another and reveal the full communicative potential when the text is read as it was intended: in a linear form from the very beginning. Finally, it has to be emphasized that the mere presence of metaphors in the theory of evolution does not undermine its accuracy or value. However, we cannot ignore their presence either. While metaphors cannot be banished from scientific communication, I believe that awareness of their existence and impact can improve the quality of that communication.

We begin our inquiry into Darwin's metaphors with his conceptualization of evolutionary change as motion through space elaborated as JOURNEY (*cf.* Drogosz 2013). Modification of forms of species over time is the fundamental claim of the theory. It is frequently described in *The Origin* and exemplifications of the metaphor EVOLUTIONARY CHANGE IS JOURNEY are easy to find, for instance:

- (8) I attribute the **passage** of a variety **from** a state in which it differs very slightly from a parent **to** one in which it differs more, to the action of natural selection in accumulating differences of structure in certain definite **direction**. [41]
- (9) Although in many cases it is most difficult to conjecture by what **transitions** an **organ** could have **arrived** at its present state. [158]

- (10) By comparing the accounts given in old pigeon books [...] with these breeds as now existing in Britain, India, and Persia, we can, I think, clearly trace the **stages** through which they have insensibly **passed**, and **came** to differ so greatly from the rock pigeon. [31]
- (11) [...] but we see so many strange gradations in nature [...] that we ought to be extremely cautious in saying that any **organ or instinct, or any whole being**, could not have **arrived** at its present state by many graduated **steps**. [371]

The basic elements of the domain of JOURNEY are projected onto the domain of evolutionary change: forms of species or organs correspond to a moving entity, which moves from a starting point / earlier forms towards later forms / the destination of motion covering some stages on the way. Such a description, which in time has become conventional in evolutionism, evokes an image of forms of species or organs travelling in time and morphing on the way, with the human observer watching this transition from the vantage point of the present time. Figure 1 represents this image schematically.

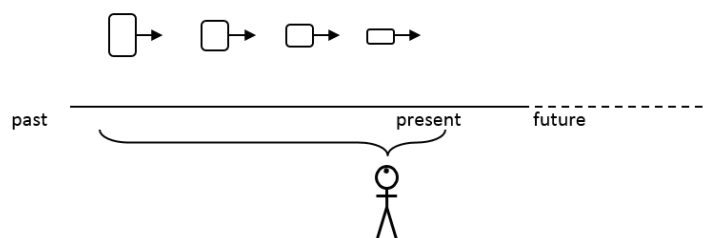


Figure 1. A schematic representation of the EVOLUTIONARY CHANGE IS JOURNEY metaphor

However, Darwin's descriptions of evolutionary change show that metaphorical projections are not limited to the basic elements of the JOURNEY domain. The rich experiential knowledge about the domain of motion, both our own motion and observations of moving objects, is used to theorize about evolution when Darwin talks about directionality of changes (12–13), describes the appearance of traits typical of earlier forms as reversion (14–16), and showing unfavourable features as deviations from the right path (17–18).

- (12) [...] natural selection will always tend to preserve all the individuals varying **in the right direction** [...] [85]
- (13) And I look at varieties which are in any degree more distinct and permanent, as **steps toward** more strongly marked and permanent varieties; and at the latter, as **leading to** sub-species, and then to species. [44]
- (14) [...] our domestic varieties, when run wild, gradually but certainly **revert** in character to their **original** stocks. [14]
- (15) [...] these same species may occasionally **revert** to some of the characters of their ancient progenitors. [138]
- (16) In both varieties and species **reversions** to long-lost characters occur. [382]
- (17) [...] natural selection destroying any which **depart** from the proper type. [86]
- (18) As natural selection acts by life and death – by the preservation of individuals with any favourable variation, and by the destruction of those with any unfavourable **deviation** of structure. [159]

The systematic correspondences between the source domain of JOURNEY and the target domain of EVOLUTIONARY CHANGE are summarized in Table 2.

Table 2. EVOLUTIONARY CHANGE IS JOURNEY: metaphorical correspondences

JOURNEY	EVOLUTIONARY CHANGE
a traveler / a moving object	a form of a species / a variety of species / an organ
the starting point	an earlier form of a species/variety/organ
the path	successive generations
the endpoint/destination	a later form of a species/variety/organ
a stage of a journey	a form of a species/variety/organ at a given moment of time
the direction of motion	from the past (earlier forms) to the future (later forms)
reversion	showing traits typical of earlier forms
deviation	showing unfavourable traits

The use of the JOURNEY metaphor by Darwin should not be interpreted as an act of special creativity on his part, just the opposite. The metaphor CHANGE IS MOTION is a conventional metaphor, part of the larger EVENT STRUCTURE metaphor discussed by Lakoff and Johnson (1999: Chapter 11). It can be assumed that Darwin was not conscious of metaphorical description of evolutionary change as no qualification “metaphorically” can be noticed in this context. His readers, both critical and sympathetic, seemed oblivious to this metaphor as well. Equally opaque and equally essential for the framing of Darwin’s theory is objectification of change that we discuss next.

As we have stated above, the fundamental claim of evolutionism is that forms of organisms undergo modifications. Although modifications are small, when accumulated over immense span of geological time they lead to emergence of new species. This accumulation of little alternations is responsible for the morphing of forms of organisms as visualized in the journey metaphor. From the point of view of conceptual semantics, cumulative effect of small changes relies on the ontological metaphor, whereby abstract domains are conceptualized as material entities or substances (Lakoff & Johnson 1980: Chapter 6; Kövecses 2002: 34).⁴ In the case of species modification, the abstract concept of change (which technically is a perceived discrepancy between two causally related states at two moments of time) is conceptualized and described as material substance that can be accumulated over time, grow in size and significance, and be transmitted to next generation, that is through the MODIFICATION IS SUBSTANCE metaphor. In Darwin’s own words:

- (19) [...] why should we doubt that variations in any way useful to beings, under their excessively complex relations of life, would be **preserved, accumulated, and inherited**. [379]
- (20) Natural selection can only act by the **preservation and accumulation** of infinitesimally small inherited modifications. [79]

The MODIFICATION IS SUBSTANCE and EVOLUTIONARY CHANGE IS JOURNEY jointly serve to conceptualize and describe evolution or descent with modification and the fact that forms of

⁴ An insightful theory on the importance of ontological metaphors and the process of objectification or granting the status of an object has been proposed by Aleksander Szwedek in a series of papers (e.g. Szwedek 2008, 2011, and 2014).

species are not immutable. The logical consequence of that view is that forms of species long extinct but attested by fossils as well as diverse species living now must be related. Such relationship of species was described by Darwin through the metaphor of FAMILY and depicted by a tree diagram (*cf.* Drogosz 2009).

Throughout *The Origin*, Darwin describes affinities among organisms in terms of family relationships referring to earlier forms of species as *parent species/forms*, *progenitors* and *ancestors*, and later forms as *descendants*:

- (21) [...] there will be a constant tendency in the improved **descendants** of any species to supplant and exterminate their original **parent** [100]
- (22) By the theory of natural selection all living species have been connected with the **parent-species** of each genus, by differences not greater than we see between the varieties of the same species at the present day; and these **parent-species**, now generally extinct, have in their turn been similarly connected with more ancient species; and so on backwards, always converging to the **common ancestor** of each great class. [228]

It is important to realize that Darwin uses the concept of family in metaphorical sense as he does not mean literal relationships between generations of organism but among abstract forms of species or even organs.

The conceptualization of affinities among organisms through the family metaphor goes hand in hand with their representation as a genealogical tree or tree of life. In his book Darwin provides a tree diagram in which earlier forms of species correspond to letters at the bottom of the diagram, their modifications and ensuing new species are represented as nodes and branches, and the letters at the ends of the topmost branches stand for the latest forms. This diagram is important for the theory because of many reasons. Firstly, it stimulated innumerable visualizations and the tree of life has become a hallmark of the theory. Secondly, and more importantly for our investigation, it triggered language related to its description making expressions such as *lines of descent*, *branching off from a common progenitor*, *a perfect chain of the intermediate links*, *connecting links* commonplace in *The Origin* and later evolutionary texts, for example:

- (23) [...] numberless **intermediate** varieties, **linking** most closely all the species of the same group together, must assuredly have existed. [146]
- (24) [...] [two plants] [...] they are united by many **intermediate links**, and there is evidence showing that they descend from common parents [...] [42]
- (25) [...] all living and extinct beings are united by complex, radiating, and circuitous **lines of** affinities into one grand system [...] [369]

Interestingly, while Darwin initially uses these expressions to describe the diagram, they gain independence as the book progresses and become used without any clear association with the picture. The third consequence of the tree diagram takes us back to the conceptualization of evolutionary change as motion in space. Description of this diagram makes the metaphorical motion almost literal when, while looking at the tree, we actually see the earlier and later species as locations, postulated forms in between as intermediate, and the connections between earlier and later species as lines of descent. Finally, the vertical orientation triggers positive association with the high position in the tree equating high with complex and improved, for example:

- (26) [...] the passage from one **stage** of difference to another and **higher** stage [44]
- (27) [...] for in all cases the **new** and **improved** forms of life will tend to supplant the **old** and **unimproved** forms. [228]

This axiological load inherent with orientational metaphors GOOD IS UP and COMPLEX IS UP is discussed later in the paper.

So far we have seen how (evolutionary) change was described by the MODIFICATION IS SUBSTANCE and EVOLUTIONARY CHANGE IS JOURNEY metaphors, and the FAMILY and TREE metaphors were used to describe affinities and resulting similarities among organisms. In this way we have addressed Darwin's claims that forms of organisms change as a result of small changes accumulated over time, give rise to new species, which makes different forms of species related. The next fundamental tenet of Darwin's theory to be discussed is the role of struggle among organisms ("struggle for existence") as a cause of organismic changes.

A struggle for existence "inevitably follows from the high rate at which all organic beings tend to increase" (Darwin 1998: 53). The idea of struggle among organisms due to limitations in natural resources came to Darwin when reading the social treatise *An Essay on the Principle of Population* (1789) by Thomas Malthus (cf. Ruse 1996: 139; Young 1985: 40). Description of relationships among organisms in antagonistic terms is commonplace in the text. Examples in (28–29) are just a tiny sample.

- (28) [...] in the state of nature, where the trees would have to **struggle** with other trees and with a host of enemies, such differences would eventually settle which variety [...] should **succeed** [...] [71]
- (29) But in one particular sense the more recent forms must, on my theory, be higher than the more ancient; for each new species is formed by having had some **advantage** in the **struggle for life** over other and preceding forms [...] [271]

The metaphor of struggle applied to the organic world is elaborated more than any other metaphor in *The Origin*. While relatively schematic domain of struggle would be fully sufficient for the logic of Darwin's argument, he pushed the metaphor towards rich images of war, involving battle, conquest and invasion, on the one hand (30–33), and of competition, including race, on the other (34–35).

- (30) [...] bearing in mind that the tropical productions were in a suffering state and could not have **presented a firm front against intruders**, that a certain number of the more vigorous and **dominant** temperate forms might have **penetrated the native ranks** and have reached or even crossed the equator. The **invasion** would, of course, have been greatly favoured by high land, and perhaps by a dry climate [...] [305]
- (31) Thus, **from the war of nature**, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. [396]
- (32) If two great regions had been for a long period favourably circumstanced in an equal degree, whenever their inhabitants met, the **battle** would be prolonged and severe; and some from one birthplace and some from the other might be **victorious**. [263]
- (33) One large group will slowly **conquer** another large group, reduce its numbers, and thus lessens the chance for further variation and improvement. [103]

- (34) The **competition** will generally be most severe, as formerly explained and illustrated by examples, between the forms which are most like each other in all respects. [259]
- (35) Hence, rare species [...] will consequently be beaten in the **race for life** by the modified descendants of the commoner species. [91]

The highly elaborated metaphor RELATIONSHIPS AMONG ORGANISMS ARE WAR shows a set of systematic mappings, presented in Table 3 below.

Table 3. RELATIONSHIPS AMONG ORGANISMS ARE WAR: metaphorical mappings

Source domain: WAR	Target domain: RELATIONSHIPS AMONG ORGANISMS
conflict participants	species / individual organisms
battlefield	natural environment / an area inhabited by organisms
victory	survival / having progeny / replacing indigenous organisms
victors	surviving species/organisms
weapons	advantageous modifications
invasion/conquest	appearance of new organisms in an area
defeat	extinction/disappearance of organisms from an area they used to inhabit
natives / inhabitants of a country	organisms indigenous to an area
foreign troops / intruders	organisms migrating to an area

In Darwin's vision, the struggle obtains on many levels of nature's organization: between organisms and natural environment (36), between organisms for the natural resources (37) and between earlier and later forms of species (38).

- (36) But a plant on the edge of a desert is said to struggle **for life against the drought** [...] [53]
- (37) The struggle will generally be more **severe between species of the same genus**, when they come into competition with each other [...] [64]
- (38) Hence the improved and modified descendants of a species will generally cause the **extermination** of the parent-species [...] [259]

This richly elaborated multi-level antagonism is reflected in the frequency of occurrence of conflict-related vocabulary. A count of words in *The Origin* that refer to struggle in nature has revealed that "struggle" appears 95 times, "competition" – 45 times, "battle" – 12, "conquer/conqueror" – six, and "war" – five times. While the WAR metaphor is undeniably an inherent part of Darwin's line of reasoning as an important cause of evolutionary change, this in itself does not explain the high frequency and variability of the struggle vocabulary.⁵ We believe that the extent of use the struggle metaphor can also be attributed mainly to its rhetorical effect. The conflictive scenario allows for a dynamic and rich-in-detail description of nature, because it appeals to reader's emotions and triggers their imagination. It simply

5 By comparison, in *An Essay on the Principle of Population* (1789) by Thomas Malthus the word "struggle" (obviously in social context) appears twice in the 1st edition (1798), six times in the 6th edition (1826), "contest" – twice, "competition" (in the market) – four times, and "conquest" also twice. In *Principles of Geology* (1830–1833) by Charles Lyell, another book that hugely influenced Darwin, the word "struggle" is used only four times in the entire three-volume work.

makes an interesting reading. Darwin appears to be almost seduced by this metaphor and indulges himself in almost poetic descriptions (e.g. 30, 32, 33).

The last metaphor to which we turn is connected with the most important construct of Darwin's theory: natural selection. Natural Selection is defined in *The Origin* as process or principle:

- (39) I have called this **principle**, by which each slight variation, if useful, is preserved, by the term of Natural Selection, in order to mark its relation to man's power of selection. [52]
- (40) This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection. [68]

However, the description of natural selection throughout the book highlights its agentive role in emergence of new species. This agency is frequently expressed through personification with different degrees of elaboration. Most of the time Darwin focuses on agency of natural selection (41–43), but there are also descriptions, in which projections from the domain HUMAN BEING include intentionality and read as fully-fledged personifications (45–46).

- (41) Natural selection can **modify and adapt** [...] [72]
- (42) [...] natural selection will always **tend to preserve** all individuals varying in the right direction [85]
- (43) [...] natural selection **destroying** any which depart from the proper type [86]
- (44) [...] natural selection **will always succeed** in the long run in **reducing and saving** every part of the organisation [122]
- (45) [...] and natural selection will **pick out with unerring skill** each improvement [...] [154]
- (46) It may metaphorically be said that natural selection is daily and hourly **scrutinising**, throughout the world, the slightest variations; **rejecting** those that are bad, **preserving and adding up** all that are good; silently and insensibly **working**, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. [70]

Personification of natural selection was the last major metaphor presented in our analysis. In what follows we discuss functions that these metaphors play in Darwin's theory as well as their consequences for the theory.

4. Darwin's metaphors: functions and consequences

As we have mentioned earlier, the literature on metaphors in scientific discourse is diverse and extensive. In this paper, we would like to limit our attention to the functions that the discussed metaphors have in Darwin's book and later to speculate about the possible impact they had on the logic of Darwinism. We discuss the following functions of these metaphors: their contribution in providing coherence for Darwin's argument, the rhetorical function of making the text more convincing and interesting to read, the catachretic function of providing vocabulary to new ideas, the exegetical function of explaining new concepts, and finally the theory-constitutive function.

The ability of metaphors to make a text more coherent, convincing and interesting is by no means limited to scientific discourse. In the case of *The Origin*, the metaphors used to describe Darwin's fundamental claims are neatly interconnected reinforcing one another and providing coherence to Darwin's argument.⁶ Thus, the metaphor of TREE visualizes motion projected from the domain of JOURNEY, fusing stages of journey with nodes of the diagrammatic tree, and journey's end-point with ends of branches. Both the TREE and JOURNEY metaphors rely on the metaphorical conceptualization of change as SUBSTANCE, and natural selection functions as an AGENT using struggle for existence among organisms to superintend that change. At the same time, metaphors make the text more interesting to read. As we have already mentioned, the STRUGGLE metaphor has the effect of making the description of relationships in nature more dynamic and emotional. The tree diagram and metaphor related to it allow for a visualization, and personification of natural selection turns a vague and abstract concept into a powerful agent whose actions can be described in familiar terms of human activity.

The next function that metaphors play in Darwin's theory is to "introduce theoretical terminology where none previously existed" and thus to "remedy gaps in vocabulary" (Boyd 1993: 481–482), that is the function of catachresis. When Darwin was presenting his theory to the public, he had to express his ideas in language. However, because some of his ideas were new or interpreted in a new way, there was no established language to communicate these ideas. Metaphors allowed him to communicate new concepts by making reference to familiar source domains of experience (JOURNEY, STRUGGLE, FAMILY, PERSON) and extending vocabulary associated with these domains. In time, these expressions have become the conventional language of evolutionism.

The second group of metaphors typical of scientific discourse, termed "exegetical or pedagogical metaphors" by Boyd, "play a role in the teaching or explication of theories" (Boyd 1993: 485). "They can be paraphrased, since they only aim at explaining or illustrating a scientific phenomenon for which a perfectly adequate, alternative original expression exists. [...] They are neither original nor argumentative, but merely descriptive" (Knudsen 2003: 1249). I believe that the metaphor of family and tree, at least to a certain extent, play such a role. While the tree is a very powerful visualization, and after over 150 years of exploitation it has become part and parcel of the theory, initially its main function was to facilitate understanding the theory.

Boyd contrasts exegetical metaphors with theory-constitutive metaphors and this is the last and most important function we want to discuss with reference to Darwin's theory. Boyd argues that metaphorical expressions of this type "constitute, at least for a time, an irreplaceable part of the linguistic machinery of a scientific theory: cases in which there are metaphors which scientists use in expressing theoretical claims for which no adequate literal paraphrase is known" (1993: 486). Their use "encourages the discovery of new features of the primary and secondary subjects, and new understanding of theoretically relevant respects of similarity, or analogy, between them" (Boyd 1993: 489). In other words, theory-constitutive metaphors provide not only language to talk about scientific concepts or facilitate comprehension, but they also are used in reasoning within a science: the logic of source domain affects the logic of a studied scientific domain.

Cognitive Semantics offers an interpretation of theory-constitutive metaphors from the perspective of metaphorical entailments, which obtain when rich knowledge about a source domain is mapped onto the target and used in reasoning about it (*cf.* Kövecses 2002: 94). Darwin's conceptualization of

6 The organic interconnectedness of Darwin's premises is also discussed by Gould (2002: 147)

evolutionary change relies on the metaphors of JOURNEY, SUBSTANCE and the tree diagram. The rich experiential knowledge of motion in space coupled with our experience with material substances reinforces Darwin's argument of the necessity of small, gradual changes, accumulated over long periods of time and growing in size and importance. Both the domain of motion and the schematic tree diagram promote the conceptualization of evolution as a linear process and creating "lines of descent" connecting past and present species. What is more, such connections seemed to Darwin a logical necessity:

- (47) [...] numberless intermediate varieties, linking most closely all the species of the same group together, **must assuredly have existed.** [146]

The requirement of connecting intermediate forms remains active in contemporary reasoning about evolution: finding new fossil intermediate forms supports the theory, while pointing to "missing links" in the chain of intermediate forms undermines it.

Not only the propositional knowledge but also axiological charge is projected from source domains in accordance with the Axiological Invariance Principle (cf. Krzeszowski 1997: 156–161). The domains of STRUGGLE, JOURNEY and TREE have the emergent entailment of progress and improvement. It is most obvious in STRUGGLE, which entails that victors must be somehow better than the defeated. If the victors pass that advantage to the next generation, then the next generation will be improved in comparison to parents. Thus, the surviving forms must be better (meaning better adapted or fit, in evolutionary terms) than those they supplant. The concept of progress is inherent in the domain of JOURNEY and has been interwoven into the logic of evolutionary thinking: since better adaptation to biotic and abiotic environment is the goal of evolution, and natural selection is postulated to work towards that goal, later forms must be closer to the goal, that is better adapted. At the same time, showing traits typical of earlier forms is interpreted as regression and showing traits not obviously useful as deviation from the right path. Both are valued negatively as impediments on the way to the goal. The tree of life metaphor brings its own valuation grounded in the image schemas of GOOD IS UP and COMPLEX IS UP, and positively charges contemporary forms of organisms as located both higher in the tree and at the ends of its branches. Interestingly, such valuation is absent from genealogical trees (there seems to be no conventional valuation either of ancestors or progeny) and seems to emerge from the interconnection with the JOURNEY and STRUGGLE metaphors. Although it was not Darwin's intention, all entailments of these metaphors converge to yield the conclusion that the human being is not only the end-product of evolution but also its highest achievement.

Personification of natural selection also plays a theory-constitutive function in *The Origin*. Natural selection conceptualized as a personified agent performs the role of the cause of change and ensuing adaptation, the role so crucial in Darwin's theory. Interestingly, personification of natural selection aroused strong criticism after the first publication of *The Origin* in 1859. In subsequent editions, Darwin tried to emphasize metaphoricity of his descriptions and grew increasingly frustrated because analogical personification of gravity in Newton's theory passed unnoticed, as Gillian Beer remarks in the Introduction to Oxford edition of *The Origin*. Darwin was also unable to remove personification from the text and theory, as the pressures to personify natural selection come from too many and too diverse sources: the tradition to personify Nature, the empty slot for the agent role once the supernatural agent was removed, an analogy with artificial selection with a clear human agent, and even the structure of the English language, which demands grammatical subject and associates it prototypically with a human agent (cf. Drogosz 2011). What is more, the conceptualization of natural selection as an agent persists in

contemporary evolutionism, though it is typically realized through the FORCE metaphor (e.g. *pressures of natural selection; selective pressures; evolutionary pressures*).

5. Concluding remarks

In this paper we explored the most important conceptual metaphors of Darwin's theory: JOURNEY, SUBSTANCE, FAMILY, TREE, STRUGGLE, and PERSONIFICATION. We believe that Cognitive Semantics approach is useful in revealing how these metaphors frame the theory and express it in language in a comprehensive, convincing, coherent and interesting way. This approach also shows the consequences of these metaphors for some aspects of reasoning within evolutionism. Finally, Cognitive Semantics perspective asserts that metaphorical language in a scientific theory cannot be avoided, yet an analysis of such language can contribute to higher awareness of metaphoricity in science and hence improved communication. At the same time evolutionary texts offer very rich and valuable material for the study of conceptual metaphor: beginning with Darwin's personal notes on the theory, through the subsequent revised editions of *The Origin*, and then 150 years of texts by various authors, both academic and popular including multimodal communication (graphics, films, etc.). Thus, evolutionary texts constitute a large and well-documented source of data for diachronic studies of metaphors, their origin and development, realization in modalities other than language, or in words of Bowdle and Gentner (2005) "the career of metaphors."

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