



Cognitive-methodological functions of metaphors

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ABSTRACT

The paper analyzes the cognitive functions of metaphors present in both colloquial and scientific discourse. First, presented is the history of research into linguistic metaphors, followed by a discussion of the psycholinguistic turn towards metaphors as thought schemas (George Lakoff and Mark Johnson), as well as metaphoricality embodied in gestures, images and behaviors and their socio-cultural contexts. Based on the analysis of metaphors in the natural sciences, mainly in physics (Max Black, Mary Hesse, Thomas Kuhn) as well as in psychology (Douwe Draaisma), the heuristic and methodological functions of metaphors in science are discussed. Finally, on this basis, a general model of the cognitive functions of metaphor is constructed in which, apart from the cognitive communicative functions, emphasized are also the pragmatic aspects of metaphorical thinking.

KEYWORDS

metaphor; conceptual metaphor theory; embodied metaphors; embedded metaphoricity; heuristics and the methodology of metaphors; scientific discourse

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INTRODUCTION

Metaphor is the subject of many theoretical and methodological approaches — from strictly linguistic analyses, literary and critics studies, through psycholinguistic and epistemological analyses, to anthropological and cultural studies. The prevailing so far concepts of metaphor as a literary ornament and style as well as a rhetorical trope — in which attention is paid mainly to the linguistic structure of the metaphor juxtaposed with metonymy, synecdoche or catachresis — are nowadays widely (in inter- and intra-disciplinary paradigm) extended to analyses of mental structures and behaviors in which verbal (or as expressed in another medium) metaphors find their root cause. The enrichment of metaphors with a psycholinguistic dimension does not end with the reconstruction of the mental conceptual schemas within which they are interpreted. For several decades, there has also been a tendency to study specifically “embodied” metaphors, which consists in searching for non-mental reasons for metaphorical speaking, thinking and acting. This embodiment of metaphors is currently present within two complementary research perspectives. The first is the study of the kinesthetic, perceptual and gestural base of human bodily behavior (Cienki & Müller, 2008), from which emerges (usually spontaneously and unconsciously) metaphorical thinking and speaking. The second research perspective involves the study of various carriers and means of metaphors such as the visual means of artistic expression such as advertisement, paintings, symbolic representations etc. (Forceville, 1996; Forceville, 2008), performative visual installations, as well as music (Zbikowski, 1998). According to the assumptions of these research perspectives, all metaphors assume a universal formula in which concrete and material objects, their distinctive features, ones well known, serve as the source domain (vehicle) to represent (metonymically, parabolically or in a synecdochic way) something that is general, universal, yet unknown (or not known well) as the target domain. Metaphors make comparisons based on the analogy of various domains, describe something new using well known means, open new views, stimulate creative thinking and action. This indicates the importance of metaphors as a specific, creative and effective cognitive means of learning about reality. They are an important tool for describing, understanding, simulating or modeling a reality about which original and meaningful metaphorical phrases are formulated.

This text is, first of all, an analysis of the forms of the metaphorical thinking and performing formulated in the current of traditional analyzes of linguistic metaphors. Secondly, it is a reconstruction and modeling of various cognitive functions fulfilled by metaphors. Thirdly, it is an analysis of selected examples of the metaphorical representation of the epistemological category of knowledge, its scientific and common understanding, essentially, however, it

is an analysis of the descriptive and persuasive functions of metaphors in which “knowledge” is both the target and source domain. In this way metaphors become an effective means coordinating and conditioning action as well as coping with complex practical-cognitive situations when something new and/or astonishing must be compared to what is better known.

1. WHAT ARE METAPHORS AND HOW THEY FUNCTION

1.1. FROM RHETORIC TO LINGUISTIC SIGNIFICANCE OF FIGURATIVE TROPES

Traditional comprehensions and concepts of metaphor — ascribed to Aristotle (Aristotle, 1984), ancient rhetors (*e.g.*, Quintilian, Cicero), then continued by baroque orators and writers (*e.g.*, Giambattista Vico) and Romantic philosophers (*e.g.*, Johann G. Herder), the semantic theory of metaphor renewed at the beginning of the twentieth century, as well as relation-oriented theories (Richards, 1935) and interrelation-oriented theories (Black, 1962; Ricoeur, 1975) — have been based on a few simple and general assumptions telling one what they do in the realm of language, how they function in speech and text, and what their syntactic-semantic structure is. This long-term and more or less concise and continuous tradition could be summarized in a few crucial moments.

Firstly, metaphor is mainly, if not exclusively, a linguistic form of writing as well as a rhetorical figure (trope) of speech and/or text. Metaphors, thanks to their rhetorical power, can also provoke their users to open new cognitive perspectives, something Aristotle has expressed as follows:

Liveliness is specially conveyed by metaphor, and by the further power of surprising the hearer; because the hearer expected something different, his acquisition of the new idea impresses him all the more. His mind seems to say. “Yes, to be sure, I never thought of that” (Aristotle, 1984: 18–21 [1412a]).

Metaphoric expression is nevertheless mostly literary style and poetic imagination as well as a method of persuasion in communication and public opinion. Metaphors widely used (considered just from the grammatical perspective) are rather deviations from the proper and literal use of words and sentences (to which David Davidson limited the real essence of metaphor *per se*; cf. Davidson, 1978). In describing one thing in terms of another thing, event or process, they are not specially cognitively significant (not so much as, for instance, reasoning, induction or deduction) because they do not grasp the essence of things (as pure reason or intuition do), but only in a round-about way telling

what it would be, just in a parabolic and mediated way, but not directly and veraciously.¹

Secondly, metaphors are all the same effective (which is exactly expressed in the semantic theories) in recognizing and expressing similarities and analogies between different things, processes and events. In drawing similarities between two things or phenomena, metaphors are, to some extent, comparable with metonymies which draw in turn contiguity between them; both tropes have thus similar cognitive functions emphasizing the possibility of obtaining new information about what is similar. Their syntactic and semantic structures of mapping (representing) the features of what is particular and empirical (source domain, vehicle) onto what is general and abstract (target domain). According to classical conceptions the metaphor (as well as the simile or synecdoche) assumes the following simple syntactic-semantic formula: (1) “X is Y” or “X is like Y”, in which X (target domain; general concept or idea) is considered (analyzed, cognized) on account of some aspect (trait, feature, property, function) of a Y (source domain, concrete phenomenon); in other words, the metaphor formula explains what X is in terms of Y’s features.

But metaphors should also be considered — while explaining their not only (less or more stable) grammatical structure but also cognitive and performative functions — much further than just as a syntactic-semantic formula (if at all reconstructable), namely from the pragmatic (practical) aspect of the formula (1), namely with the inclusion of the fact that: (2) For a definite subject (actor, agent) S the fact that “X is like Y” decides that he/she on the whole better perceives, understands and/or acts in reference to X on account of a specific S’s experience of Y, which usually happens within the framework of particular Z conditions of this experience; in other words, S metaphorically explains (using formula (1)) what X is (is like) under material, social or cultural circumstances and the contexts which he/she undergoes.

Formula (1), which tells us about the structure of each metaphor, and its pragmatic aspect (2), which specifies the conditions of the context in which metaphorical thinking and action occur, together constitute the way in which metaphors function in everyday experience, as in scientific discourse. (Conditions (1) and (2) will be used to characterize the model of the metaphor’s cognitive functions that will be presented in paragraph 4.)

Between X and Y the transition and change of meanings associated with them (something which relation- and interrelation-oriented theories have only noticed and merely assumed) takes place. On account of these subject S not only better notices and understands reality but also more efficiently acts and

¹ The question as to if metaphors are warrant linguistic-cognitive means providing the truth (justifiable knowledge about the target domain) is a separate epistemological problem (Stern, 2000: 262–267) and will not be considered in this paper.

works in reference to his/her everyday experience. Under such environmental (contextual) Z conditions the metaphors are both embodied and embedded. They are embodied since they are more or less direct expressions of bodily movements and actions of S; they are in turn embedded since they are realized (implemented) in the material means of form of expression like words, sentences, pictures, sounds, gestures, visual media *etc.* Both embodiment and embedment are crucial for the practical (instrumental) usage of metaphors in learning and education as well as in scientific inquiries and other organization of knowledge.

Paul Ricoeur (Ricoeur, 1976; Ricoeur, 1978) turns to the new aspect of the problem of metaphoricality, which is nevertheless considered within the framework of the traditional rhetorical-linguistic approach, when he speaks of the necessity of its semantic as well as of psychological interpretation. He supplements the important communicative and informative role of the metaphor with an even more important cognitive one, which he sees (partly after Aristotle and mainly after Kant) in the imagination to which every metaphor refers. By imagining not only new meanings of expressions (substituted by others, as the substitutionist conception of metaphor assumes, *e.g.*, the Aristotelian), but also by presenting to oneself new features and properties of objects and phenomena, a subject who uses a linguistic metaphor (not only a word, but a whole sentence or phrase), as well as thinking metaphorically, comes to know reality better, more fully, and even more truly. Such a broadly conceived metaphorical character of language and thinking, recognized also in Husserl's notion of *epoché* and in Heidegger's *in der Welt Sein*, Ricoeur further connects (*i.e.*, apart from its cognitive function) with man's emotional attitude towards the metaphorically named reality. He summarizes his position as follows:

there is a structural analogy between cognitive, the imaginative, and the emotional components of the complete metaphorical act and that the metaphorical process draws its concreteness and its completeness from this structural analogy and this complementary functioning (Ricoeur, 1978: 159).

1.2. COGNITIVE TURN AND THE EMBODIMENT OF METAPHOR

The passing from a merely linguistic and only partially cognitive treatment of metaphors (limited to comparing different things and changing meanings) towards to broadened cognitive-semantic approach (paradigm) was carried out in the 1970s and 1980s, when the psycholinguists George Lakoff and Mark Johnson made the "metaphors we live by" the subject of their broad theoretical and empirical research. They mainly focused their interest on the mental and

conceptual (not exclusively language-oriented aspects of metaphors) which have been treated as prevailing and pervasive means in human experience and cognition as well as kinesthetic behavior. The precursors of the “metaphoric turn” mentioned that: “We have found that metaphor is pervasive in everyday life, not just in language, but also in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature” (Lakoff & Johnson, 1980: 3).

The shift made in the metaphor paradigm towards broader cognitive aspects bears special fruits in studies on such human cognitive processes like categorization, prototyping or defining, which had been omitted by the previous theories. In their “spatialization form hypothesis” and “orientational metaphors conception” Lakoff and Johnson hold that the most common procedure in metaphorization is the mapping of the agent’s image schemas (concepts, intellectual ideas) into the target domain which she or he wants to explain through this operation. Mapping is a transfer of the features of the perceptual-imaginative and behavioral schemas onto more abstract domains like ideas, symbols or values. Sensual percepts, mental images or depicted images (pictures, graphics, paintings *etc.*) as well as gestures or performances (bodily movements like dance) serve as a source domain to represent (to map) what is categorized, conceptualized, modeled or verbalized in the target domain; metaphorization is exactly passing between both domains but it happens primarily at the mental and conceptual levels not only at the linguistic. There is, Lakoff and Johnson hold, a variety of elementary image schemas involved in such processes, and these are: time and space correlations, before-after sequences, top-down and/or bottom-up orientations, upward and downward motions, horizontal and vertical orientations, moving, manipulating, controlling *etc.* Metaphors emerge from the very simple experience of human undergoings in their environments, where precisely a spatial orientation of the human body in its surroundings (*i.e.*, sensor-motor correlations, position, body movements *etc.*) takes place (Gibbs, 2006). As Lakoff and Johnson say:

There is an internal systematicity to each spatialization metaphor. [...] Spatialization metaphors are rooted in physical and cultural experience; they are not randomly assigned. A metaphor can serve as a vehicle for understanding a concept only by virtue of its experiential basis (Lakoff & Johnson, 1980: 17–18).

The experiential grounding of each metaphor does not mean that it is invariant of any social or cultural influences; on the contrary, metaphors are influenced by culture too. Since there are many places “where metaphors come from”, as Zoltán Kövecses admits (Kövecses, 2015), the socio-cultural context plays a crucial role in metaphors production and their understanding. Metaphors exhibit constant (invariable) bodily spatial structures and modes

in human experience, they result from the spatial position of a body in concrete surrounding. This is why Lakoff holds:

Strictly speaking, the spatialization of form hypothesis requires a metaphorical mapping from physical into a “conceptual space”. Under this mapping, spatial structure is mapped into a conceptual structure. More specifically, image schemas (which structure space) are mapped into the corresponding abstract configurations (which structure concepts) (Lakoff, 1987: 283).

All that happens between the levels of bodily and mentally spatialized schemas in the agent’s experience. Metaphoricity, shortly speaking, is literally embodied in the agent’s experience — in his/her immediate bodily kinesthetic reactions towards his/her environment — as well as embedded in different presentations — from the verbal and textual, through depicted to gestural and performative bodily manifestations.

The cognitive turn initiated by psycholinguistic studies, which heightened for the theoretically orientated analyses of metaphors a more empirical and cultural character, nevertheless opened up some ambiguous and disputable perspectives. One of them is the question — what weaknesses and self-limitations, apart from their unquestionable cognitive profits, do metaphors evoke and imply? If a metaphor, rooted not only in the words but also in bodily experience as well as being involved in the cultural context, opens up new perspectives on previously unseen and unimaginable aspects of things and processes, what do they at the same time, as happens to any cognitive tool, not notice or omit and even obscure? As with any new insight, similarly with a shedding light making certain phenomena visible, it also casts a shadow on them. This epistemologically significant rule (one of these was considered by Paul Ricoeur in *Rule of metaphor*, 1975) is by no means metaphorical expression of metaphor cognitive power but yet a literal explanation of what happens when a parabolic trope operates; a certain paradox occurs thus as an unavoidable effect of metaphorical thinking, speaking and doing.

The question of why metaphoric thinking is responsible for the abovementioned effect has absorbed the attention of philosophers and cognitive linguists from the very beginning of the metaphorical paradigm. Observed by Lakoff and Johnson is that: “a metaphorical concept can keep us from focusing on other aspects of the concept that are inconsistent with that metaphor” (Lakoff & Johnson, 1980: 10). Raymond W. Gibbs goes further in finding some self-limitations of metaphors and has recognized a specific “paradox of metaphor” in which metaphor is creative, novel, culturally sensitive, and allows us to transcend the mundane while also being rooted in pervasive patterns of bodily experience common to all people” (Gibbs, 2008: 5). In other words, being all around the metaphor, one cannot easily free oneself from its cognitive and

persuasive power. This seemingly contradictory, somehow ambiguous nature of metaphoric thinking means also that people who are (more or less unconsciously) engaged in it are not able to exceed their bodily and culturally entrenched limits. Transcending what is empirically evident and entering cognitively into new domains of experience, they are additionally determined by the no less significant empiric constrains of their bodies — brain functions, the gestures or customs which govern people's actions. All of these circumstances clearly show that metaphoric thinking is deeply involved in all our cognitive and practical endeavors.

2. COGNITIVE FUNCTIONS OF METAPHOR IN SCIENCE

Metaphors fulfill cognitive functions that can be compared in some respects with requirements concerning scientific concepts and theories, namely — recognition of analogies within various (generally very different) phenomena and their comparison which result in metaphors. The juxtaposition of stylistically and content-rich metaphors found in colloquial language, as well literature and religions, or in the language of politics, with strict scientific definitions has often been the subject of conceptions and theories within the philosophy of science and general methodology. Many historians of science, methodologists and researchers (Black, 1962; Hesse, 1966; Arbib & Hesse, 1986; Kuhn, 1993; Fojt, 2009; Zeidler, 2013) have found that the language of science is multilaterally entangled in metaphorical phrases that come to it from colloquial language, are fixed in scientific terminology, and do not change, remaining in it permanently, assuming the form of definitions and strict terms. They have also noted that the language of science, especially in physics (even in Newtonian, not only Aristotelian), contains terms and concepts that originally entered it as metaphors. Examples of which are such concepts as, to mention just a few (from modern physics), field, force, or mass. Being originally terms of everyday language, denoting things in man's immediate environment (being in connection with the body and life processes), such concepts and terminology enter into a wider use in science; however, one should remember that, for instance, "mass" had connotations originally of the material characteristics of a concrete body (object) measured in kilos or other parameters. They passed then, metaphorically speaking, from living metaphors to dead metaphors whose origin (*e.g.*, a former life in everyday experience) is not so rarely forgotten. "Perhaps every science must begin with metaphor and end with algebra, and perhaps without the metaphor there would never have been any algebra" — Max Black summarizes the essence of this methodological phenomenon (Black, 1962: 242). Metaphor stimulates and enriches all scientific discourses, thus it is a crucial cognitive

instrument in achieving new information about any aspect of the considered natural phenomena. It is, contrary to popular opinion, more cognitively active and creative in exploring the world than literary and strict definitions. "It would be more illuminating in some of these cases to say that the metaphor creates similarity than to say that it formulates some similarity antecedently existing" (Black, 1962: 37). This means creative thinking is therefore an indispensable tool for generating new knowledge in particular fields of science, something E.R. MacCormac stresses by stating that "without [metaphors] humanity would find it difficult to extend its knowledge into the unknown, and language would be largely static" (MacCormac, 1985: 50). Metaphor in the natural sciences may be, which is worth noting, no less important and cognitively significant than in the humanities or social sciences, where it has reigned unchallenged for centuries.

Michael Reddy's (Reddy, 1993) remarks on figurative speech about communication and cognition provide important insights into the role of metaphors in the sciences. Following the main assumptions of Lakoff and Johnson's conceptual metaphor theory (especially "spatialization form hypothesis"), he coins the concept of conduit metaphor in order to explain statements and proverbs of both ordinary and scientific language in which knowledge, cognition, information and communication are expressed metaphorically. All these cognitive phenomena are explained in terms of technical devices like channel, pipeline, conduit as well as processes like coding/decoding, signal transmitting, message conveying, transporting etc. Metaphorical presentations which tackle them are expressed in such phrases as: "Your reasons came through to me", "I gained from you that information", "It's difficult to put my ideas into words", "His words carry little meaning", *etc.* They are expressions of mental schemas (possessed both by speakers and hearers) in which the conceptualization of knowledge and cognition as specific "objects" functioning among people takes place. Thus human communication is conceived as transmitting information identified with thoughts, ideas and their verbal or written forms, and which happens among people who intentionally formulate thoughts and next convey them to others. It takes a simplified shape (Reddy calls it a "major framework") of a linear, serial, one-directional and determined process. One of the reasons why such a concept is stable is Lakoff and Johnson's "spatial metaphoricity" and "orientational metaphors" (Lakoff & Johnson, 1980: 14–21) deeply rooted in human experience, in which people (both specialists and laymen) perceive the thoughts as a content of verbal containers incorporating the full content of the message.

The "minor" framework overlooks words as container and allows ideas and feelings to flow, unfettered and completely disembodied, into a kind of ambient space between human heads. In this case, the conduit of language becomes, not sealed pipelines from

person to person, but rather individual pipes which allow mental content to escape to, or enter from, this ambient space (Reddy, 1993: 170).

According to this paradigm, the communication process is conceived as face-to-face relations between individuals, as the multi-directional sending and spreading of signals between the broadcasters; psychical (sensory experiences and feelings) as well as technical (radio or television) elements functioning as empirical references for the model (while also being the source domain) ultimately create an evocative conduit metaphor. Reddy suggests that such a model of communication and information does not encompass all types of human communications.

He proposes another one called the “toolmakers paradigm” — a model in which both quantitative (signal-oriented) and qualitative (mental) aspects of human communication and knowledge are respected. This model renounces (or at least minimizes) the theory of cognition and information as being one thing, and communication as the transfer of thoughts (subtle “things”). Reddy exposes more sophisticated explanations (still metaphorical ones) convergent with certain Claude E. Shannon and Warren Weaver assumptions (Shannon & Weaver, 1948/1964) formulated in their “mathematical theory of communication”.² It metaphorically conceives communicating agents (typically people) as relatively isolated in slightly different environments, located in (in Reddy’s words) “a huge compound, shaped like a wagon wheel” exchanging only a small set of generally informative instructions about what they do and how they cope with their environments. All that happens, as the newly built metaphor suggests, “at the hub of the wheel” where the agents’ exchanges (being in Shannon and Weaver’s conception an abstract “one’s freedom of choice”) involve not the information-things, but only instructions (meta-information) about them. Communication in a broader sense consists then, Reddy concludes, on neither the simple sending of the signals (as the conduit metaphor suggests) nor the receiving of them as packed information portions. It is in reality more complex, and it is better explained by the probabilistic aspect of the mathematical theory of information, in which the assumed “choice of possibilities” explains precisely what the senders and receivers do while they exchange the signals. Choosing a concrete situation and set of signals means not only obtaining information, but being involved in informational situations, which can be metaphorically expressed as being rather “at the hub of the wagon wheel” and choosing instructions for further possible reactions, than the “packing or unpacking information-thing in containers sent alongside a conduit” (Reddy, 1993). In both cases of the communication/information conceptions metaphorical thinking is unavoidable, however, the later metaphor is better than the former.

² For more detailed analyses of these issue see: Hetmański, 2015.

Telling examples of the dominance of metaphorical language in the study of mental and cognitive phenomena are provided by psychology, where metaphors have always served to produce new knowledge about them. They do it through linguistic and semantic operations on terms and their meanings that consist in changing the meanings of old terms and introducing new associations and more meaningful concepts. Douwe Draaisma, who studies memory metaphors present in psychological and scientific discourse, states in *Metaphors of memory* that any “interaction which is evoked by a metaphor will be more intense the more finally branched the networks of associations around both term are” (Draaisma, 2000: 13). The condition for the originality of a metaphor is to take over the meaning associations (which every new word and/or concept possesses) already existing both in the target and source domains and then to “mutually and productively select and organize” them in order to produce even more original networks of associations of meanings resulting in a general concept (*i.e.*, in the target domain). Metaphors produce thereof new semantic associations of meanings, the network of which constitutes the semantic field of each metaphor; such a network is, in turn, an area of successive transformations and rearrangements. Each of these semantic operations is described metaphorically by reference to phenomena from everyday life — concrete things like field, network, area, association — whose characteristics (as a source domain) serves as the properties of the phenomenon under study. “The ‘semantic fields’ are in that case so fruitful that after the first harvest a second and a third may follow” — so Draaisma concludes metaphorically the process of creating metaphors (Draaisma, 2000: 13). The creation of metaphors rich in new meanings is a process that is subject to change, but generally it ends with the creation of a stable and unchanging concept — a dead metaphor that, again metaphorically speaking, goes out of fashion.

Like all human creations metaphors are subject to wear and to tear and the process of interaction between the two domains which is set in motion by a metaphor may become fainter and finally disappear. The phenomenon of “dead metaphor”, the metaphor which has gradually become the literal expression, is the end result of this process (Draaisma, 2000: 13).

The most original and creative metaphors always reach the end of their cognitive functioning. They work as long as the mutual interaction of their meanings reveals as yet unrecognized or hidden features of the target phenomenon. However, as soon as the semantic field disperses and the network of associations between meanings loosens, metaphors cease to be understood by people, including the scientists familiar with them. Then they become just an ornament of language and do not play their former creative cognitive function.

3. METAPHORS AS HEURISTIC AND METHODOLOGICAL TOOL

In the methodology of the natural sciences, no less than in the social sciences, metaphors have not had a good reputation as a tool in knowledge producing and acquiring. Recognized merely as only rhetoric devices or occurring at a pre-reflective level of reasoning and proving, they have been restricted, if not excluded totally, from serious scientific undertakings. Nevertheless, they are constantly present, as demonstrated in the following examples, in scientific procedures, especially in heuristics and theory formulation in particular scientific disciplines. Jerome Bruner, having regard for the human and social sciences, notices “that forging of metaphoric hunch into testable hypothesis goes on all the time” and takes place in most of scientific activities, however, researchers have tended mostly to give their theories and hypotheses, as well as their publications, an “aseptic quality cleansed of metaphorical impurities” (Bruner, 1965: 5). Despite this self-limiting tendency found in the social sciences metaphorical thinking serves effectively here to create knowledge as well as to communicate it.

Metaphors are, Draaisma notes again, a preliminary stage in the formulation and operation of any theory using verbal as well as pictorial means; both measures serve in the same way to create and communicate knowledge. “Through their combination of image and language, of graphic and abstract, metaphors are ideally suited to explaining and teaching theories” (Draaisma, 2000: 15). They are a way not only to learn about a complex phenomenon, but also to formulate and announce results on it, as well as to lecture and teach theories about it; both the communicative and explanatory functions are in fact inseparable. They delimit and define new facts, as well as propose their first hypothetical account, and in this way they fulfill also an important heuristic role in scientific practice and discourse.

Theoretical heuristics means that a metaphor introduces a new theoretical notion, brings coherence to hypothetical processes or is able to resolve apparent contradictions between experimental results, while empirical heuristics describes the degree to which a metaphor produces new topics for research (Draaisma, 2000: 18).

But metaphors also have a less favorable side. Suggestive figurative formulations can hide or even falsify some aspects of the phenomenon under study that, due to the harsh light of the metaphorical expression, remain (metaphorically speaking) in its shadow. Metaphorical cognition, being inherently aspectual, generally reveals those features of the phenomenon that it finds significant, while it relegates others to the background or omits them altogether.

[M]etaphors make one part of information more visible, but do so by eliminating the rest of the information. In the directing, filtering and selecting of the attention there

is the implication that the information which originally present is reduced. This has negative effects in both theoretical and in empirical respects: theoretical notions which are not noticed, hypotheses which are neglected, relationships which are removed from view, research topics which are ignored (Draaisma, 2000: 19–20).

Because of the persuasive-retrospective form in which metaphors appear in science or everyday discourse, they often dominate other kinds of cognition. A suggestive theme from the source domain of a metaphor — some detailed feature (sensuously exposed), an original aspect of a thing, a paradoxical phenomenon, etc. The author of *The metaphors of memory* claims therefore that one should rather talk about the subjects of metaphors than about metaphors themselves. It ultimately results in the fact that if metaphors already appear in a given scientific discourse, it is not their linguistic form that is most important, but their hypothetic-heuristic functions played out in specific research situations. If they are a heuristic tool of scientific knowledge, they should function relatively permanently; any change or displacement can lead to negative consequences. Metaphors once applied to a field of knowledge cannot and even should not be changed, Draaisma notices, they can only be further developed creatively but carefully.

The fact that metaphors fulfill an important methodological role is emphasized also by Susan Haack (Haack, 1994), noting that they directly participate in the conduct of scientific inquiry. In her opinion metaphors are neither good nor bad as regards the results to which they can lead, they are simply natural and effective means of cognition. Therefore their place in scientific research, as in everyday thinking and reasoning, depends on the particular cognitive situations which they metaphorically describe. The figurative and parabolic language of most metaphors is not, Haack remarks, a disqualifying obstacle or failure in scientific inquiry, as centuries of disputes in modern philosophy indicate,³ because the heuristic rather than the rhetorical-stylistic functions

³ Haack shows that the seventeenth-century attempts made by philosophers to omit metaphorical phrases in philosophy were counter-effective, because metaphysicians were using figurative tropes all the time. She remarks that John Locke's famous phrase that "since wit and fancy find easier entertainment than dry truth and real knowledge" in which he demystified — paradoxically, still in a figurative style evaluated as misleading and not proper for philosophical discourse — the "figurative applications of words eloquence" (passages from his *An essay concerning human understanding*) was really ambiguous since he did use this type of language too. In the same way Thomas Hobbes was unsuccessful in eliminating figurative tropes from philosophical discourse, saying that: "Metaphors [...] are like *ignes fatui*; and, reasoning upon them, is wandering among innumerable absurdities" (passages from *Lewiathan*). In historical studies Haack sums up by citing the significant remark made by John Stewart Mill that many metaphorical phrases are apt to fallacy of equivocation, namely, by the confusing of "is" (meaning "exists") with the copula that brings about (in Mill's words from *System of logic* cited by Haack) "[the] fog which rose from this narrow spot diffuses itself at an early period over the whole surface of metaphysics".

of figurative thinking are more important. What really matters is the fact that metaphorical thinking can guarantee satisfactory cognitive results in proportion to the phenomena they describe.

Metaphors are sometimes cognitively vital; not seldom illuminating; perhaps more often than not at least harmless. Metaphors can also be feeble; can be exploited to the purpose of persuading by emotional appeal rather than rational argument; can serve as lazy substitutes for adequate theoretical articulation; can lead inquiry into what turns out to be quite the wrong direction. Metaphor is neither a Good Thing nor a Bad Thing in end of itself; it is, rather, a linguistic device capable of being put to good or bad use, sometimes a help, sometimes harmless, sometimes a hindrance (Haack, 1994: 4).

An adequate theory of how a metaphor works — Haack calls such a theory the “epistemology of metaphor” — ought to make it possible to explain both the usefulness and the dangers it can cause, focusing primarily on the heuristic and methodological aspects of metaphorical thinking. “I shall be arguing that the locus of the most interesting cognitive role of metaphor is in exploratory phases of inquiry” (Haack, 1994: 13). Explaining this role is possible only at the level of theoretical analyzes when the researcher moves from describing the inquiry itself to reconstructing its scheme, in other words, when he moves from merely the methodological to the fully epistemological level of analyzes.

4. MODEL OF COGNITIVE FUNCTIONS OF METAPHOR

The abovementioned observations being made on the basis of the analyses of the functioning of metaphors at all levels of knowledge and stages of scientific procedures, particularly in physics and psychology, allow us to formulate some significant theses about the methodological side of this cognitive means. They can be put into the following model which includes the functioning of metaphors in both natural and social sciences as well as their crucial elements constituting the core of the considered model. This model, in addition to the strictly cognitive aspects of metaphor exposed in the foreground, also reveals its rhetorical and communicative aspects as being complementary to the cognitive one.

The following model takes into account two important issues that have been taken into account in recent research on metaphoricality in its broadest sense: First, the grammatical-syntactic structure in which both verbal metaphor and its embodied (gestural, visual, pictorial) realizations appear. Second, the bodily types of experience of subjects using metaphorical expressions, as well as the contexts in which they are realized. Both issues — the linguistic and pragmatic dimensions of metaphoricality — are dealt with in Paragraph 1.1 in the form

of formula (1) and its practical entanglement in aspects of formula (2); mentioning them here serves to highlight the strictly cognitive — heuristic and methodological — functions of metaphors in scientific discourse.

(1) Metaphors describe in more than one case (although not with the same accuracy) complex, implicit, dynamic and changing phenomena, mostly hidden and not yet the best known, by comparing them (*per analogiam*) with what is (being their source domain) already sufficiently known and theoretically recognized. Showing new information and new cognitive perspectives is their main goal.

(2) They not only describe, but also creatively and originally (even paradoxically) capture certain aspects of reality; this is especially the case, however, not necessarily the universal case, with the so-called creative metaphors, which might advance the understanding of complex reality in new ways.

(3) Metaphors are the heuristic tool with a certain power in relation to the people who use them, namely: (3.1) they recall from long-term memory relevant information related to the target domain due to the detail of the features of the phenomenon described in the source domain, and (3.2) they store them in long-term memory (both live and/or embedded (coded) in material systems) as well as participate in their (3.3) memorization in a permanent and effective (repeatedly recalled) way, also based on live and physical systems. Thus such metaphors store and process knowledge.

(4) They evaluate a recognized and named phenomenon (from the target domain), value it by juxtaposing the familiar with the new, the simple with the complex, the explicit with the implicit, *etc.* The possum-valuing effect is then a function directly proportional to the originality and novelty of the semantic field of the metaphor (its semantic associations network).

(5) Metaphors sometimes (but not always) evoke not only cognitive but also emotional attitudes in their users, which they achieve by juxtaposing particular features from the source domain, mostly unusual or paradoxical, and then relating them to the target domain. They also appear (again, not always) as epithets through the rich semantic associations of a key term juxtaposed with a blunt term; by evoking an emotional attitude, such metaphors stimulate more subdued, extra-analytical attitudes (*e.g.* curiosity).

(6) They communicate their content in public discourse by drawing the attention of the audience to distinguished (sometimes overexposed) aspects of the phenomenon about which they are metaphorically declaring something.

(7) Metaphors stimulate the subject's concrete action in scientific areas and research practices. They have also a great rhetorical power thanks to their suggestive reference to both obvious and new (intriguing) features of studied phenomena by means of which they bring closer the target which becomes then the object of interest on the part of the researchers themselves as well as those interested in scientific research.

(8) They also have, mainly thanks to their persuasiveness and suggestiveness, the power to convince the authors (both individual and group) of the metaphorical discourse as well as its recipients, encouraging them to take advantage of its benefits. As peculiar cognitive-heuristic shortcuts, metaphors spare excessive description, giving subjects, especially in particular scientific disciplines, a sense of cognitive accuracy and conceptual mastery of the complex phenomena and topics.

Not all metaphors fulfill all the above mentioned structural features and functions which exist in at least a potential state (suitable for a discipline) and are realized only under favorable conditions; moreover, they do not fulfill them all at once, nor in the same order or to the same degree in any cognitive situation. The juxtaposition of these eight features and the cognitive-practical functions that metaphors can fulfill should be treated merely as a model of metaphorical thinking, that can be applied in relatively fixed (not always and not everywhere) situations, depending on the context of a particular scientific discipline and/or everyday experience. The model can also be used for many purposes, firstly to classify and evaluate all linguistic tools, apart from metaphors, also metonymies, synecdoche or ellipsis, used to describe complex processes and phenomena, secondly to study them in their cognitive functions relativized to a given discipline. Namely, one can expect that a particular metaphor, after discerning its proper structure — distinguishing the two domains, the leading theme, the network of associations of meanings in the semantic field — and applying it to the model, will be properly recognized and evaluated. The model can be helpful in recognizing the proper nature of phenomena and processes — their complexity, multilevel character, contextuality, dynamism, etc. Shortly speaking, the model can serve as a tool with an important exploratory and predictive value, from whose functioning important epistemological conclusions can be drawn.

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