RIFL (2016) 2: 21-33
DOI: 10.4396/20161206

Metaphor: the good argument in science communication

Giulia Frezza
Sapienza University of Rome
giulia.frezza@uniroma1.it

Abstract The relation between metaphor and argumentation in science communication is becoming a crucial tool for critical metaphor studies. In this article, by means of a crossed analysis (epistemological, cognitive and linguistic), I focus especially on a peculiar dynamic of metaphor use in scientific communication showing opposite, paradoxical attitudes towards the use of metaphors, respectively, ubiquity vs. invisibility, inclination vs. resistance, deliberate vs. non-deliberate. In this way, an overall philosophical reflection about the underlying reasons for the ambivalence in the use of metaphor in scientific communication would be proposed and discussed.

Keywords: metaphor and scientific argumentation, metaphor analysis, resistance to metaphor, critical discourse analysis, science communication.

Received 18 July 2016; accepted 30 October 2016.

0. Introduction

In spite of the renowned epistemological studies about metaphor in science (e.g. HESSE 1966, WEINGART *et al.* 1995), metaphor's role as legitimate scientific tool is still in part controversial, somehow conflated with the more established notion of model (WIMMER, KOSSLER 2006). Historical and epistemological reasons could possibly explain this fact, which yet is beyond the scope of this article. Here, a typical opposition between the demand for clarity and rigor vs. the need for metaphorical open expressions in scientific language can be categorized by means two opposite behaviours: inclination for metaphor (*positive*) and resistance to metaphor (*negative*). As this article will discuss, these behaviors are both part of our linguistic nature and are even more emphasized in science communication.

Nowadays science is specialized, layered, and complex, so its language is becoming increasingly intertwined and interdisciplinary. A focus on argumentation in scientific language and in science communication has become an essential part of the picture. Metaphor, especially, is proven a useful tool for discussing epistemological, social and ethical issues involved (e.g. NERLICH *et al.* 2016). In the international journal *Nature*, for instance, one finds an on-going debate about the use of metaphors in scientific explanation (BALL 2011).

In the light of this flourishing debate a new field of critical metaphor analysis emerged that is linked with the subfield of discourse analysis, i.e. critical discourse analysis. The studies by Nerlich's and her colleagues are a benchmark for acknowledging the state of the art in this field and for assessing what promising directions should be developed. Throughout the last years their approach targeted the evolution of metaphors in biomedicine, synthetic biology, climate change and ethics, describing paradigmatic changes by means of metaphor's shifts, and changes in narratives through times (e.g. CRAWFORD *et al.* 2008; HELLSTEN, NERLICH 2011, NERLICH *et al.* 2016).

They have also claimed that there is a need of filling the gap between ethics, the studies of scientific communication and metaphor, proposing a coherent direction of research on both ethical and metaphorical dimensions of science communication (NERLICH *et al.* 2016).

Another approach to this topic consists in observing more in detail how scientific metaphor functions in the argumentation strategies of science communication. In scientists' and media's speech, the argumentation style often mirrors asymmetries in information and in judgment between experts and general public (JASANOFF 2005). Moreover the argumentation strategy may be informed by a general assumption (not necessarily explicit) about the need of keeping control (at least with words) of the uncertainty of risk factors (PROCTOR, SCHIEBINGER 2008) for instance involved in experimenting a novel therapy, or trying to predict the effects of living closed to environmental disaster areas which entail a wide array of health problems. Science, as a matter of fact, does not have the power of monitoring risk without doubt. Scientific research is an open process which involves doubt and risk. This eventually leads to a dialectic between different actors (scientists, experts, journalists, politicians, regulators, physicians, opinion leaders, general people) in the use of argumentation for talking about controlling risk and assuming responsibility, or in other words *risk management* (DE MARCHI, RAVETZ 1999).

From the viewpoint of metaphor studies, these asymmetries and dialectic may result in diverging argumentative narratives that are often expressed by metaphors. For instance, the metaphoric argumentation "Illness is a war and we have to fight it" serves as a shortcut for making clear from physician's, and more generally from health system's viewpoint the urgency of action. By contrast, the same metaphor according to the patient may sound obnoxious: Who exactly is in war with whom? And where exactly is meant to be the battleground? The narrative entailed by this war-metaphor is extremely controversial.

The relation between metaphor and argumentation in science communication, therefore, could be better explored for identifying underpinning mechanisms at play in this peculiar context of communication. In this article I will focus especially on a peculiar dynamic of metaphor use in discourse showing opposite, paradoxical attitudes about the use of scientific metaphors: ubiquity/invisibility, inclination/resistance, deliberate/non-deliberate. My inquiry, then, will move from the following question: are there specific patterns underlying argumentation that may explain these paradoxical attitudes towards metaphor in scientific communication?

In Section 1, I will first briefly outline the traditional epistemological opposition ubiquity vs. invisibility of metaphor in science that has been discussed in detail elsewhere (FREZZA, GAGLIASSO 2016). In Section 2, I will analyse two other natural conflicting behaviours towards metaphor, inclination vs. resistance, in scientific argumentation by means of four different examples. In Section 3, I will draw to the deliberate vs. non deliberate character of metaphor. Therefore, in Section 4, a threefold dimension of the use of metaphor in science could be outlined dealing with the three paradoxical attitudes towards metaphor: (i) *epistemological* showing metaphor's paradox of *ubiquity*/*invisibility*; (ii) *cognitive*, expressing *inclination/resistance* to metaphor; and (iii) *linguistic*, observing the *deliberate/non-deliberate* character of metaphor. Afterwards, I will propose a preliminary philosophical background discussing the social "shared making of metaphorical meaning" in ordinary language (NERLICH, CLARKE 2001). And, in order to further spell out the underlying mechanisms in the opposition between inclination/resistance towards scientific metaphor I will refer to Cavell's philosophical proposal of human intrinsic scepticism, epitomized by metaphor use (CAVELL 1994; FRISARI 2010). In the Conclusion, this crossed perspective (linguistic and conceptual) would be further discussed, contributing to develop an overall philosophical reflection about the reasons for the ambivalence in the use of metaphor in scientific communication.

1. The paradox of ubiquity and invisibility of metaphors in science

Voir, c'est déjà une opération créatrice, ce qui exige un effort.
Henry Matisse

One of the traditional criticisms made to the use of metaphors in scientific language has its roots in the ambivalence of ancient rhetoric, which claimed that metaphor can make the truth appear as well as give falsehoods the consistency of the truth (BLUMENBERG 2010). An opposition ensued between scientific argumentation – direct, logical and rational – and metaphor, which by contrast has ambiguous, intuitive, automatic, and oblivious features. This entails consequences, for instance, when observing the underlying cognitive processes of argumentation, where a tendency to ignore metaphors and emotions was highlighted leading to what has been dubbed a "cognitive prejudice" actually present even in the embodied cognition framework (ERVAS et al 2015).
An old champion of this kind of reasoning can be found for instance in Hobbes:

> A man that seeks precise truth, had need to remember what every name he uses stands for; and to place it accordingly; or else he will find himself entangled in words, as a bird in limetwiggs; the more he struggles, the more belimed (HOBBES 1651, 1, Ch 4: 28).

As anyone would acknowledge, Hobbes, in describing precise truth and clear meanings, is using both a metaphor (*entangled in words*) and a simile (*as a bird in limetwiggs*). Hobbes' quotation highlights a typical feature in the debate about metaphor in scientific language: science tends to deny the use of metaphor, even when it is expressly making use of it. This process contributes to the generation of the ubiquity vs. invisibility of metaphors in science, spelled at length elsewhere and that will be briefly synthetized (FREZZA, GAGLIASSO 2016).
In old and current biology, medicine, ecology, genetics and neurosciences, for instance, there is a continuous production, spreading and establishment of metaphors. Metaphors are legitimate research tools for heuristics and cognition (such as in the classic metaphors of mind-computer, black-box, genetic-code, network, noise, mirror-neurons, epigenetic landscape), and they are the ancient roots of theoretical terms (individual, cell, genome, environment) (GAGLIASSO 2008) and of

influential theories (ecology, artificial intelligence, epigenetics). Metaphors in life sciences are everywhere, thus one would acknowledge their *ubiquity*, yet when scientists and the general public consider traditional notions such as organism, environment, cell or heredity, the origin of their metaphorical meaning often gets lost. This leads to the *invisibility* of most ordinary scientific metaphors – as also happens in general language use in the common process of the crystallization of metaphors (BLACK 1993).
Anyhow, not all metaphors become scientific terms. Therefore, there should be more, still unidentified, mechanisms at play in scientific argumentation that are bound to specific contexts of creation, use and consideration of metaphors.

2. Inclination vs. resistance to metaphor in science

The paradox of ubiquity/invisibility of metaphors in science can be paralleled to the inclination/resistance to metaphor. Without aiming to offer an exhaustive overview, I will consider four examples displaying four main arguments towards scientific metaphor: (1) a nominalist view of scientific language, (2) a pragmatic argument, (3) a heuristic argument and (4) a creative view of scientific language.
The first example comes from *Nature's Books and Arts blogs*, where a blog dubbed *The Last Word on Nothing* is running a sporadic series on the issue of scientific metaphors. Finkbeiner, the science writer, discusses supernovas' colour degeneracy with an American astrophysicist. They engage in a debate about the metaphoric vs. conceptual use of *degeneracy*, which leads to a tipping-point: «Words just mean what they mean» because they «don't keep the meaning of their origins» (FINKBEINER 2011). Finkbeiner argues that, with regard to «electron degeneracy» and «degenerate matter», anyhow «degenerating means falling away from your nature, from the higher, truer, nobler kind that you are and to which you belong» (*Ivi*). The astrophysicist instead «had no truck with such romantic linguistics», and explains his nominalist view of scientific language by the following example: (1) «Once a word is defined in math or physics "*it just means that*"», and he quoted Lewis Carroll: «"When I use a word", Humpty Dumpty said in rather a scornful tone, "it means just what I choose it to mean – neither more nor less". Maybe a little of a word's original flavor leaks through, he added, but "words don't keep the meaning of their origins"» (*Ivi*).
Let's dub the astrophysicist's a purely nominalist view of scientific language: in science, words have monosemous meanings and don't keep their original meaning. Finkbeiner disagrees with the scientist and concludes that «I swore to God that no one, scientist or not, can use the word 'degenerate' entirely separate from its original meaning. The uses of words are not separate from their origins» (*Ivi*).
The second example comes from another astrophysicist, who conversely does support the use of metaphor in science (SCHARF 2013). Even though he acknowledges that there are some issues at stake in the use of metaphor, for instance that they «can sometimes backfire, confusing more than elucidating, and even swaying scientific thought in unwanted ways», the astrophysicist then displays his pragmatic view on scientific metaphor by the following example: (2) «The simple truth is that scientists themselves constantly make use of analogies, metaphorical devices, and similes. Sometimes it's the only way to build an intuition for a problem, by relating it to something else» (*Ivi*).

This example exhibits a pragmatic attitude: scientists simply make use of metaphor in research, for bad or for good. Now, moving from the negative towards a more positive account of metaphor in science one finds an article entitled *Metaphor and message* by Kiser, from *Nature's Books and Arts blogs* that epitomizes the heuristic value of scientific metaphor with the following example:

> (3) The known is a springboard to the unknown. This is how we learn. We need the familiar – and sometimes, if it serves, even the anthropomorphic – to begin to comprehend our wild cosmos. […] Through metaphor we ally ourselves to the Universe, docking in with a linguistic click (KISER 2015).

This example highlights the most accepted view of scientific metaphor: metaphors transfer (in Greek *metà-pherein*; see BLACK 1954; BLUMENBERG 2010), therefore they are a way of creating bridges between notions or fields of study that are not connected yet. This approach epitomizes scientific openness and heuristics: the capability of transferring insights from an already known domain towards the unknown (e.g. HESSE 1966).

Quoting the words of the historian of genetics Nathaniel Comfort, Kiser emphasizes this heuristic view of the use of metaphor in science by endowing it with a more creative view of scientific language by means of imagery, along with the following example: (4) «What's needed is fresh, accurate imagery, nippy enough to keep up with the evolving science» (KISER 2015).

This last example shows the creative *good side* of metaphor in science by stressing its salient pragmatic features: its grip and utility in scientific argumentation. Moreover, by means of this example, we can underline yet again the traditional opposition between the alleged closeness of science as a language and the openness of science as research.

Let's briefly recall the examples mentioned above. The first (1) is the nominalist view of scientific language supported by the astrophysicist talking about the supernova degeneracy, and expressed by Humpty Dumpty's words: «When I use a word it means just what I choose it to mean». The second (2) is the pragmatic argument by which «scientists themselves constantly make use of analogies, metaphorical devices, and similes. Sometimes it's the only way to build an intuition for a problem, by relating it to something else». The third (3) is the heuristic argument in the use of metaphor by which «the known is a springboard to the unknown. This is how we learn. We need the familiar to begin to comprehend our wild cosmos». The fourth (4) is a creative view of scientific language, which emphasizes its imagery features: «What's needed is fresh, accurate imagery, nippy enough to keep up with the evolving science».

The four examples as a whole display a range of attitudes towards scientific metaphor from denial (1) to pragmatism (2) to appreciation (3 & 4), and from resistance to inclination. Three main elements can be highlighted. First: all the speakers in the circumstances described by the examples, as well as Hobbes in the above quote, found metaphors when looking for the right words. Second: moving from example (1) (denoting resistance to metaphor) to example (4) (emphasizing the creative power conveyed by metaphors), the situation is turned upside down: instead of becoming «entangled in words as a bird in limetwiggs» as stressed by Hobbes, scientific language needs to look for imagery terms as much creative as possible to keep up with the creativity of science. Third: speakers' argumentations above highlight that, although people pragmatically make use of metaphors, they at the same time are convinced that there aren't *only* "good metaphors".

The main issue emerging from the analysis of the examples is that notwithstanding the differences between all the arguments proposed (nominalist, pragmatic, heuristic and creative), in the end there is only one scenario: the speakers are caught in a dual attitude showing a resistance/inclination for metaphor. At the same time, speakers do not seem to have the capability to establish a valid criterion for distinguishing a good or a bad metaphor that is of great help when theorizing and communicating science (FREZZA, LONGO 2010). Moreover, often scientists and general people when using/hearing a metaphor might be unaware of their motivations for resisting or appraising it.

As showed by Matisse's quote in the opening of this section: even looking is a creative process, which requires an effort. Becoming aware of the use of scientific metaphor yet requires an effort: coming out from the paradox of ubiquity/invisibility and inclination/resistance to metaphor in science.

In this way, traditional issues such as the role of metaphor in heuristics as well as the entanglement between the power of metaphor and its risk in communication may be better explained especially if considered in the light of the deliberate use of metaphor as discussed in Deliberate Metaphor Theory (DMT) (STEEN 2013). Not far from a more inclusive approach between rational and unconscious cognition in psychology, or slow and fast thinking (KANHEMAN 2011; GIGERENZER 2007), DMT discusses how, in contrast with the idea of a fallacious, automatic and ambiguous use of metaphors in discourse and argumentation, intentional (but not necessarily conscious) constraints are at play too. In other words, we can and do use some metaphors deliberately, although we are not always "conscious" of them (STEEN 2015). A paradox between the use of deliberate vs. non deliberate metaphor ensued: not all metaphors are comprehended by what is traditionally considered the usual mechanism, that is online cross-domain mapping, but only deliberate metaphors (STEEN 2008). This implies broadening the study of metaphor and considering the use of metaphors, also scientific metaphors, from this inclusive and multilevel standpoint, as deliberate, intentional, and as possible routes to conceptual abstraction (JAMROZIK *et al.* 2016; FREZZA, GAGLIASSO 2016). The rationale underlying DMT is that when people become aware of their use of metaphors they could also develop a more critical thinking and more critically assess their behaviour.

3. Social bond and the power of metaphoric argumentation

A threefold dimension of the use of metaphor in science can now be proposed and paralleled to the three paradoxical attitudes towards metaphor shown in the previous sections: (I) epistemological, showing metaphor's paradox of ubiquity/invisibility, (II) cognitive, expressing inclination/resistance to metaphor, and (III) linguistic, observing the deliberate/non-deliberate character of metaphor. Considering these three dimensions, novel mechanisms can be outlined that are at play in the background of the argumentation strategy in science communication.

First of all, two principal contexts of speech should be identified: I) science (expert-to-expert communication); II) science communication (expert-to-general public communication). Whilst science is a non-ordinary speech context, when moving towards science communication the language becomes increasingly entangled with ordinary speech. Ordinary speech is the ground zero of the analysis, devoid of the contextual constraints of expert-to-expert scientific communication, which runs at a higher level. At this stage we may expect the most natural conditions, mechanisms, and behaviours to be expressed through the use of metaphoric argumentation. Metaphor has been thoroughly studied from rhetoric, linguistics and cognitive perspectives (e.g. LAKOFF, JOHNSONN 1980; GIBBS 2008) as well as in ordinary language. In this respect, Nerlich's and Clarke's pragmatics of polysemy (2001) offers an analysis of dual readings in metaphor and discourse.

The authors explain the basic social pragmatic effect of polysemous speech as the fact that we have evolved a linguistic capacity to move from precise and monosemous to vague and polysemous acts of speech depending on the situation and the discourse style. Metaphor is an integral part of the pragmatic effects of polysemy. Polysemous and metaphoric expressions are ways of keeping language alive, invigorating ordinary language use by means of an active process between speakers and hearers which collaborate in a «shared meaning making and remaking» (NERLICH, CLARKE 2001: 9). Often shared meaning-making is literally a joint action between hearer and speaker who agree on the word's meaning; otherwise one of the discussants proposes his/her private meaning and waits for the other's consideration and approval in a dialogical exchange. In science communication this process is yet particularly emphasized because many issues impinge on the shared meaning-making and on the speaker's/hearer's approval, such as cultural backgrounds, asymmetries of information and different framing narratives as discussed in the Introduction. For instance, looking back at the examples we can point out some major differences. In example (4), the Nature's Books & Arts Editor, Kiser quotes the historian of genetics Comfort, who openly speaks about the creative power of metaphor as fresh and nippy (KISER 2015) language apt to communicate a science that is evolving. By contrast, in the first example (1) the agreement between a scientist and a science writer on the meaning-making about "degeneracy" metaphorical vs. literal interpretation could not be found.

However, in contrast with the assumption that the goal of communication is reducing multiple meanings, Nerlich and Clarke claim that our linguistic pragmatic competence is essential for the construction of shared meanings, which endow us not only with linguistic but also with «social bonding» (NERLICH, CLARKE 2001: 10). This idea is consistent also in the field of scientific communication. Yet in the scientific context this social disposition should be distinguished and contextualised by means of the two abovementioned different contexts: scientific communication and thus "scientific bonding", i.e. social rules shared by the scientific community and science communication and thus "scientific-social bonding", i.e. a more general level including general public and media.

The second element of Nerlich's & Clarke's analysis evaluates the cost/benefits of the pragmatic effects of communication by means of Rachel Giora's theory of graded salience (GIORA 1997). Giora describes two parallel mechanisms for processing language: the first (bottom up), stimulus driven and bound to linguistic stimuli, the second (top down) predictive and integrative and dedicated to both linguistic and extra-linguistic stimuli (GIORA 2008). The bottom up mechanism is informed by salient interpretation (characterized by conventionality, frequency, and familiarity), and salient interpretation has unconditional priority (ease of processing) over less salient interpretation. However both processing run parallel: saliency is the basic, pursued route in initial conditions (automatic), the other route is useful especially for disambiguation, reactivation of meaning or in interpreting further expression in a chain of sentences (resulting in global coherence). Therefore, in such case, lexical access, context and saliency are at interplay.

Nerlich & Clarke interpret these findings in the light of the pragmatic feature of polysemy, which keeps open in the hearer's mind multifold meanings of polysemous words and metaphors. Indeed, there is a specific cost in terms of elapsing time, which however has a benefit value socially speaking: the creation of intimacy and social bond between speakers and hearers. Going back to example (3) that emphasizes the heuristic value of scientific metaphor, the social bonding of metaphor is clear-cut (namely marked by the use of the verb "to ally"): metaphor has an intrinsic learning value as «through metaphor we ally ourselves to the Universe docking in with a linguistic click» (KISER 2015).

Moreover, the pragmatics of polysemy is akin to the idea that interest drives communication: one prefers communication that is interesting (from Leech's *Interest principle*, 1983). And among interesting characteristics there are "unpredictability" and "news value", which, provoking and engaging us, will force us to think on-line. This principle is fundamental in science communication, where difficult and abstract concepts are communicated to, and should be understood by, general public. Gaining people's interest and attention will contribute to their active role in thinking, enhancing their understanding of the concept. We may recall example (4) underlining the need of a «fresh and accurate imagery» but «nippy enough» in order to keep up with the continuous evolution of science.

Nerlich & Clarke conclude their analysis with the insightful idea that in many cases «language is used to top up the context, not the other way round» (NERLICH CLARKE, 2001: 18), because eventually in many circumstances the context does not block unintended meanings.

Elaborating this idea in the field of scientific metaphor would require a thorough and dedicated analysis; here I shall confine myself to the following issue. All characteristics – social bonding, salient traits and the interest principle – are consistent, insightful and useful criteria also when evaluating the functioning of metaphorical speech in science, as highlighted in the analysis of the four above examples. By contrast, Nerlich's & Clarke's conclusion about the predominance of language over context cannot be considered as a valid criterion in the evaluation of metaphor use in scientific argumentation. Determined linguistic competences and rules bound to the special context of "scientific bonding" are both intertwined and challenged in the more extended context of the "social-scientific bonding" of science communication. Here language and context necessarily interact and are not running parallel.

Nerlich's & Clarke's insightful proposal, therefore, when embedded in the field of scientific argumentation entails an adjustment concerning at least two specific traits. Firstly, one should distinguish the two different kinds of bonding, "scientific bonding" and "scientific-social", both with specific procedures, languages and constraints. Secondly, the use of metaphor in scientific argumentation discussed in the examples reveals an underlying tension: *inclination* for metaphor (positive attitude) and *resistance* to metaphor (negative attitude). So far, I have dealt with a linguistic perspective, now I'd like to examine the reasons of this ambivalence from a philosophical standpoint.

The American philosopher Stanley Cavell (1994) proposed that metaphor is endowed with an inherent ambiguity because it exhibits the dual relationship that, as a matter of fact, we have with our language: an appraising side (*positive*) and a devaluing side (*negative*) (FRISARI 2010). In the appraising behaviour we tend to exalt through metaphor some features of the world that we want to emphasize. Think about example (3), where the creative view of scientific language is exalted by recurring to

metaphors that allow us to «ally ourselves to the Universe». Conversely, when turning to metaphors in the devaluing behaviour we tend to resize the very reality and the weight of our statements about it. Example (1) precisely emphasized this opposition discussing the metaphorical meaning of "degeneracy" in the quarrel between the science writer sustaining that «degenerating means falling away from your nature, from the higher, truer, nobler kind that you are and to which you belong» (FINKBEINER 2011) and the astrophysicist who «had no truck with such romantic linguistics» (*Ivi*).
According to Cavell, in these opposed moves a *natural* tendency of human language is revealed: the *unnatural* spillage from its own constraints, due to the human inherent tendency to scepticism. Cavell in this way emphasizes a perpetual instability between a claim to certainty and the disclaiming of certainty. The use of metaphor exemplary shows the dual mechanism expressed in our ordinary language which, being constitutive of our social given form of life *à la* Wittgenstein, is also our genuine way of relating with the others and experiencing the world, by presenting and representing ourselves as speakers and hearers.
Cavell's explanation of the natural paradox between a claim to certainty and the disclaiming of certainty intrinsic to our language can shed light on the "natural" paradoxical resistance/inclination for metaphor in scientific argumentation. From Descartes and Kant to Popper, scientific method is a human rational solution to human natural scepticism. The sceptical move intrinsic in metaphorical argumentation, as described through Cavell's analysis, as a matter of fact poses more than an issue to scientific argumentation as discussed at length elsewhere (FREZZA, GAGLIASSO 2016).

4. Conclusion

Three highlighted paradoxical attitudes towards metaphor correspond to a threefold dimension of the use of metaphor in science: epistemological, showing metaphor's paradox of ubiquity/invisibility, cognitive, expressing inclination/resistance to metaphor, and linguistic, observing the deliberate/non-deliberate character of metaphor. Accordingly, in the light of Cavell's proposal, this ambivalence can be enlightened by the intrinsic natural scepticism embedded in our cognitive-linguistic performance. Human intrinsic scepticism, exemplary displayed in the analysis of metaphor, sheds light on the natural ambivalence and on the paradox of the use of scientific metaphor discussed in previous Sections.
In this light, we can look back at Clark's & Nerlich's idea of social bonding at play in our language production that is akin also to Cavell's proposal of "projective communication" as a solution to the sceptical underpinning of our relation with reality expressed exemplary by metaphor.
Cavell's description of language as natural relational behaviour adds a fundamental, evolutionary trait to social bonding: in the shared meaning-making and remaking, our language does not recursively develop all possible linguistic paths (as would be possible for artificial intelligence), but only those that are public and shared, and that naturally evolve across times like other natural processes, i.e. biological canalization (DEACON 1997). This implies that no matter if we are inclined or resisting metaphor, eventually language and context would evolutionary sort out the solution shared within the social environment.
As a conclusion, this would de facto confirm the position sustained in example (2), supporting the pragmatic view of metaphor: sometimes it's the only way to build an

RIFL (2016) 2: 21-33
DOI: 10.4396/20161206

intuition for a problem, by relating it to something else. However, talking about scientific metaphor, it should be recognised that the scientific bonding is twofold (within scientific community and with general people), bound to specific criteria, language, and context, and entails risks and responsibilities; something that should be acknowledged by those that make use of metaphor for communicating science.

By appraising this multifold perspective, the study of metaphor in science communication would result three times useful (epistemological, social & ethical viewpoint). From an epistemological standpoint, because usual disciplinary borders are melting away and metaphors in their heuristic value may let us “ally to the Universe” and “docking in with a linguistic click”, as in example (3). From a social viewpoint, because our globalized world and research require to deal with a renovating hybrid language, result of a melting pot of different cultures and scientific communities all over the world. Metaphors, thus, proliferate as bridges in projecting and translating the meaning of our words and of the different worlds inherent to them (DÍAZ-VERA 2015), providing new imaginary that, as in example (4), keep up with science openness and creativity. Here, the idea of metaphor as social bonding that allows dialogical shared meaning-making comes back on stage. From an ethical perspective, the great advances of research and technology, as well as their application in our daily life involve assuming responsibility in words and in practice, both by scientists, legislators, opinion leaders, CEOs and general people (JASANOFF *et al.* 2015). And metaphors in science communication are a champion for observing the dialectic between risk and responsibility.

In science communication the sceptical nature of our relation with reality intertwines with uncertainty and asymmetry of conditions (such as major conflict of interests). In spite of collapsing in the sceptical attitude described by Cavell, we might take on risk, and responsibility, for our actions and words. Science is increasingly challenged by a need to deal both with a highly specialist and popular language. As argued by example (2) metaphors represent a pragmatic shortcut for communicating in a non-specialized language and in multifarious contexts from disciplinary specialization to public communication.

In this regard, I wish to remark that a metaphor is not “just a shortcut”: it conveys a representation of the world that is more open than “Just the word”, as in the Humpty-Dumpty’s example (1). Metaphor is also powerful, unstable and paradoxical, and potentially with more impact than “Just the word”. The appraising side of metaphor, indeed, reinforces the image of reality we wish to present to the world, in a parallelism with the role played by emotions (ERVAS *et al.* 2015): either we are honest and aware of the specific meaning, inner meanings, and hidden ideologies conveyed by the metaphor, or our use of metaphor would not be frank. No matter if we are inclined or resisting to metaphor in science, as the speakers in the four examples, anyhow metaphoric communication in science should be intended as the social basis allowing to commit to our words and world rather than promoting hype attitudes in communication. Honest or dishonest, a scientist should be in the condition of making a disclosure of her/his use of metaphor, going explicit and explaining exactly the terms and the specific circumstances for which and in which she/he is using it. Responsible attitudes begin by raising awareness, and the use of deliberate metaphor in science might be a turning point of this new phase. As Black remarked in his foundational article *Metaphor* in 1954: No doubt metaphors are dangerous – and perhaps especially so in philosophy. But a prohibition against their use would be a willful and harmful restriction upon our powers of inquiry (BLACK 1954: 294).

Acknowledgements
This work is supported by Ateneo Sapienza – Progetti Interdisciplinari 2015. The author wishes to thank the editorial board for their work and Gerard Steen and Jean Wagemans for their insightful comments and suggestions most treasured for getting to the final version of this article.

References

BALL, Philip (2011), «A metaphor too far», in *Nature News*, 23 February, pp. 1-8, http://www.nature.com/news/2011/110223/full/news.2011.115.html.

BLACK, Max (1954), «Metaphor», in *Proceedings of the Aristotelian Society*, n. 55, pp. 273-294.

BLACK, Max (1993), *More about metaphors*, in ORTONY Andrew (ed.), *Metaphor and Thought*, Cambridge University Press, Cambridge, pp. 273-294.

BLUMENBERG, Hans (2010), *Paradigms for a Metaphorology,* Cornell University Press, Ithaca.

CAVELL, Stanley (1994), *In quest of the ordinary*, University of Chicago Press, Chicago-London.

COMFORT, Nethaniel (2013), «Genetics: The genetic watchmaker», in *Nature*, n. 502, pp. 436-437.

CRAWFORD, Paul, BROWN, Brian, NERLICH, Brigitte, KOTEYKO, Nelya (2008), «The 'moral careers' of microbes and the rise of the matrons, 1995-2006», in *Health, Risk & Society*, n. 10 (4), pp.331-347.

DEACON, Terence (1997), *The symbolic species,* W.W. Norton & Co, New York.

DE MARCHI, Bruna, RAVETZ, Jerry R. (1999), «Risk management and governance: A post-normal science approach», in *Futures*, n. 31, pp.743-757.

DÍAZ-VERA, Javier (2015), *Metaphor and Metonymy across Time and Cultures*, De Gruyter Mouton, Berlin.

ERVAS, Francesca, GOLA, Elisabetta, ROSSI, MariaGrazia (2015) «Metaphors and Emotions as Framing Strategies in Argumentation», in *EAPCogSci*, vol. 1419 of CEUR Workshop Proceedings, CEUR-WS.org.

FINKBEINER, Ann (2011), *Science Metaphors (cont.): Degeneracy*, http://www.lastwordonnothing.com/2011/11/24/sciencemetaphorscontdegeneracy/(last accessed 3 Jun 2016).

FREZZA, Giulia, GAGLIASSO, Elena (2016), *Building Metaphors: Constitutive Narratives in Science*, in GOLA Elisabetta, ERVAS Francesca, ROSSI Maria Grazia (eds.), *Metaphor in Communication, Science and Education*, De Gruyter Mouton (accepted), Berlin.

FREZZA, Giulia, LONGO, Giuseppe (2010), «Variations on the theme of invariants: conceptual and mathematical dualities in physics vs. biology», in *Human Evolution*, n. 25 (3-4), pp.167-172.

FRISARI, Francesco (2010), *Era solo una metafora: logiche di una svalutazione*, in GAGLIASSO Elena, FREZZA Giulia (eds.), *Metafore del vivente*, Franco Angeli, Milano.

GAGLIASSO, Elena (2008), *Organismo e individuo come arcipelaghi di metafore*, in CALABI Lorenzo (ed.), *Il futuro di Darwin. L'individuo*, Utet, Torino.

GIBBS, Raymond W. (2008), *The Cambridge Handbook of Metaphor and Thought*, Cambridge University Press, New York.

GIGERENZER, Gerd (2007), *Gut Feelings: The Intelligence of the Unconscious*, Viking, New York.

GIORA, Rachel (1997), «Understanding figurative and literal language: the graded salience hypothesis», in *Cognitive Linguistics*, n. 7 (1), pp. 183-206.

GIORA, Rachel (2008), *Is metaphor unique?*, in GIBBS Raymond W. (ed.), *The Cambridge Handbook of Metaphor and Thought*, Cambridge University Press, Cambridge.

HOBBES Thomas (1651), *Leviathan*, (reprinted from the edition 1651), Clarendon Press, Oxford 1909.

HELLSTEN, Iina, NERLICH, Brigitte (2011) «Synthetic biology: building the language for a new science brick by metaphorical brick», in *New Genetics and Society*, n. 30 (4), pp. 375-397.

HESSE, Mary (1966), *Models and analogies in science*, University Notre Dame Press, Indiana.

JASANOFF, Sheila (2005), *Designs on Nature: Science and Democracy in Europe and the United States*, Princeton University Press, Princeton & Oxford.

JASANOFF, Sheila, HURLBUT, Benjamin, SAHA, Krishanu (2015), «CRISPR Democracy: Gene Editing and the Need for Inclusive Deliberation», in *Issues in Science & Technology*, 32, n. 1, disponibile su http://issues.org/32-1/crispr-democracy-gene-editing-and-the-need-for-inclusive-deliberation/.

JAMROZIK, Anja, MCQUIRE, Marguerite, CARDILLO, Eileen, CHATTERJEE, Anjan (2016), «Metaphor: bridging embodiment to abstraction», in *Psychonomic Bulletin & Review*, n. 23 (4), pp. 1080-1089.

KAHNEMAN, Daniel (2011), *Thinking, Fast and Slow*, Macmillan, New York.

KISER, Barbara (2015) «Metaphor and message», http://blogs.nature.com/aviewfromthebridge/2015/04/30/metaphor-and-message/ (last accessed 3 June 2016).

LAKOFF, George, JOHNSON, Mark (1980), *Metaphors We Live By*, University of Chicago Press, Chicago.

LEECH, Geoffrey (1983), *Principles of pragmatics,* Longman, Harlow.

LOETTGERS, Andrea (2013), «Communication: Metaphors advance scientific research», in *Nature*, 502, 303 (17 October 2013).

NERLICH, Brigitte, CLARKE, David (2001), «Ambiguities we live by: towards a pragmatics of polysemy», in *Journal of Pragmatics*, n. 33, pp. 1-20.

NERLICH, Brigitte, ELLIOTT, Richard, LARSON, Brendon (2016), *Communicating Biological Sciences: Ethical and Metaphorical Dimensions*, Routledge, Oxford.

PROCTOR, Robert, SCHIEBINGER, Londa (2008), *Agnotology. The Making and Unmaking of Ignorance,* Stanford University Press, Stanford.

SCHARF, Caleb (2013), «In Defense Of Metaphors in Science Writing», http://blogs.scientificamerican.com/life-unbounded/in-defense-of-metaphors-in-science-writing.

STEEN, Gerard (2008), «The paradox of metaphor: Why we need a three-dimensional model of metaphor», in *Metaphor & Symbol*, n. 23, pp. 213-241.

STEEN, Gerard (2013), «Deliberate metaphor affords conscious metaphorical cognition», in *Journal of Cognitive Semiotics*, n. 5, pp. 179-197.

STEEN, Gerard (2015), «Developing, testing and interpreting Deliberate Metaphor Theory», in *Journal of Pragmatics*, n. 90, pp. 67-72.

WEINGART, Peter, MAASEN, Sabine, MENDELSHON, Everett (1995), *Biology as society, society as biology: metaphors,* Springer, Dordrecht.

WIMMER, Andreas, KÖSSLER, Reinhart (2006), *Understanding Change Models, Methodologies, and Metaphors,* Palgrave Macmillan, New York.