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A Fortress Filled with Highways

A Study on the Uses of Metaphors in Popular Neurosciences

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Neuroscience, labeled as « Sistine Chapel of science » by James G. Ballard, has been receiving a lot of public attention in France for the past thirty years. Since *L'Homme neuronal* (*Neuronal Man*) by JP Changeux (Changeux 1983), numerous popular neuroscience essays have become best-sellers. As a matter of fact, the non-fiction best-seller of this autumn in France is also inspired by neuroscience. Neuroscience is nowadays a legitimate discourse in French society, from anti-crime policies to mental health issues, from the intellectual field to the education field, from marketing to communication, and so on. People are often convinced of this legitimacy via popular science. Therefore, my object of study is : what is really transmitted through neuroscience popularization ?.

I have worked on popular neuroscience in several ways : studies on celebrated French authors such as Jean Pierre Changeux, on cultural go-betweens like publishers and journalists. This research resulted in a book published in 2014 (Lemerle 2014). I am currently working on the reception in France on Paul D. MacLean's theory of the triune brain. But I'm also working on events and « live » popularization, and that will be my topic today.

In this research, I try to understand what is happening in the course of a science popularization process and, in a first part, I will introduce the hypothesis that one of the most common features of science popularization lies in its use of metaphors and analogies. I will also introduce some of the most used of them in a popular neuroscience event that I have been attending for two years, and some consequences of this fact in terms of public understanding of neuroscience.

However, these metaphors at the SdC are less numerous than one would expect. In a second part, I'll try to explain this surprisingly narrow range of metaphors by identifying several factors in their uses in popularization discourses.

The « Semaine du Cerveau »

First, a few words about the fieldwork. The « Semaine du Cerveau », which I will call SdC from now on, is the French edition of the « Brain Awareness Week » (BAW), launched in 1996 by

the Dana Foundation in the US, as a campaign dedicated to advancing public awareness about the progress and benefits of brain research.

It was launched in France in 2000 and it is run by 700 volunteers from all the major French research institutes in neuroscience. It is held every March. In 2016, it involved 34 French towns and attracted 35 000 people (more than 8 000 people in Paris only).

It consists in open houses at neuroscience labs, lectures on brain-related topics, exhibitions about the brain in museums and universities, displays at libraries, movies and debates in theatres and community centers, classroom workshops... It provides a rich material to study the ways neuroscience is popularized. The SdC has another interest, which is being an event entirely managed by scientists and scientific institutes staff, without any cultural go-betweens. The core of the SdC initiative lies in the fact that it is thought as an encounter between researchers and the public.

1. Popularizing implies using metaphors

What SdC popularizers do

I have counted more than 250 events organized by the SdC in the Paris region since 2008, dealing with more than 300 topics. Perception is the most frequent subject (the five senses, the inner ear, and s.o.), followed by general presentations on the history of neurosciences, on memory and aging, on sleep, on neurodegenerative diseases, and other medical conditions (strokes, mental health...).

When you attend the SdC or talk with the researchers involved in it, you may find four or five main ways of popularizing. I will develop only one of them : using specific rhetorical techniques, especially analogies, metaphors, or, according to the people I spoke to, « parallels » or « images ».

Why do metaphors seem so important to produce narratives on neuroscience topic in extra-scientific contexts ?

This idea has already been formulated more than 20 years ago in various studies on popular science (McRae 1993). In his book about the writing of popular science, Yves Jeanneret stressed that metaphors are useful to scientific popularizers because they allow the public to grasp scientific concepts thanks to ordinary ways of talking (Jeanneret 1994). But he also stressed that metaphors are in fact surely necessary because of the way our mind operates. Metaphors might be a kind of natural way of thinking, according to George Lakoff and Mark Johnson. Then they might be one of the best way to convey messages.

The most influential framework for the study of metaphor is currently provided by Lakoff and Johnson's conceptual metaphor theory (or the cognitive theory of metaphor). I won't detail here this theory, which has been mentioned a lot of times since yesterday. I'd like just to stress that a lot of the metaphors used at the SdC can be analysed as combinations of primary metaphors which can make pretty sense to a non-specialist audience.

The SdC metaphors

So, what kind of metaphors are used by SdC popularizers and what does it tell us about the way scientific discourses make their way to public spheres ?

I'm well aware of the fact that I'm going to tell you about metaphors in French, and that may be an hurdle during a presentation in English. Fortunately, all the metaphors that I listed have their adequate counterparts in English.

Among the most recurring metaphors, we have :

- brain as a black box or a fortress which has to be opened ; that is to say : full of secrets that must be discovered. We have here a rather traditionnal rethoric in popular science : the «wonder of science ». The brain is often introduced as the most mysterious thing in the world.
- nervous impulses described as flowing electricity and the like : axons and dendrites as electric wires, myelin as insulating material which makes easier electric circulation.
- brain organization as neural highways and nervous impulses circulating in these roads, following signs, etc..
- at last, the famous computer metaphor, although not the most frequent and whose expression can vary : brain as a super computer, analysing data taken from the environnement in order to proceed thoughts and actions ; brain as a global positioning system...

What are the main conceptual metaphors at stake ?

The metaphors that I just listed can be understood via several conceptual metaphors identified by Lakoff and Johnson (Lakoff and Johnson 1999, 45 et sq.)

Conceptual metaphors at the SdC

- ORGANIZATION IS PHYSICAL STRUCTURE
 - Boîte noire (black box)/ Forteresse (Fortress) → Cerveau (brain)
 - Routes/autoroutes (roads/highways) → Réseaux de neurones (neurons networks)
- UNDERSTANDING IS GRASPING
 - Entrer dans la forteresse (enter the fortress) → the secrets of the brain are hard to grasp
- KNOWING IS SEEING
 - Ouvrir la boîte noire (open the black box) → what is unknown is plunged into darkness
- THINKING IS MOVING / MIND IS A MACHINE
 - Boîte noire (black box) as a flight recorder in an aircraft → thought is a motion on (neuronal) path (or highway)
 - Brain as GPS

First, the ORGANIZATION IS PHYSICAL STRUCTURE metaphor. The concept that is meant (the target domain) is « relationships unifying the brain ». It is expressed with the source domain of physical structure such as a building (fortress, black box) or a road.

In the case of the « fortress », there is another conceptual metaphor that can be identified : UNDERSTANDING IS GRASPING, but in a specific way, stressing on the difficulty to reach what is to be understood.

This leads to another primary metaphor : KNOWING IS SEEING. We can guess it from the fortress metaphor : once you break in, you will see the truth. But this also the case for the « black box » metaphor : we have to open the box, light up what is plunged into darkness and so we'll have access to the secrets of thought, the emergence of thought.

Another dimension may be implied by this metaphor : « black box », in French and in English as well, means also a flight recorder in an aircraft. This may be analysed as a complex mapping with two conceptual metaphors : THINKING IS MOVING (which can be illustrated with expressions such as « to jump to conclusion ») and THE MIND IS A MACHINE. Here, the brain is referred to as a device regulating the course of human thinking (and the rest). This is consistent with other metaphors used during the SdC : the metaphors of the brain-computer and of the brain-GPS.

The social and cultural impact of metaphors used in popular science

Why is it so important to pay attention to these metaphors ? In my opinion, because they can have a great impact on basic, extra-scientific narratives concerning the brain. Reuse of these metaphors can be conventional or more creative, but it is sure that numerous entailments of these metaphors can be then found in the social world.

Latent meanings of a metaphor can be unfolded in order to convey interpretations going beyond the original purpose. Think of the computer metaphor, which can be developed according to ideas of self-empowerment : the exploitation of all the potentialities of the machine that is in our skulls, the conviction that we only use 10% of our brain, that we can program or re-program our brain, and the like.

I can also mention the highway metaphor as it is interpreted in by a famous French personal development coach : talking of « neuronal highway », she explains that « the more a road is taken, the more we are likely to take it », in order to suggest that changing behavior is very hard.

My hypothesis is that these metaphors set a large part of the layman understanding of neuroscience and of the basic principles of brain operations. But on the other hand, the meaning of these metaphors is not fixed and may vary according to specific contexts, or, to speak with Hans Robert Jauss's words, according to the « horizon of expectations » (*Erwartungshorizont*) of the public.

2. Social determinations of the uses of metaphors

The SdC popularizers are aware of the risks inherent in the use of metaphors. They are in fact rather cautious when it comes to metaphors. This led me to think about the existence of constraints on the use of metaphors among the scientists involved in the SdC. Four types of influences can be mentioned :

The sociocultural contexts

Cultural habits have beyond any doubt an influence on the popularizers' choice and use of metaphors. As many historians showed us (Hadot 2004) (Eamon 1994) (Pesic 2000), the idea of nature as a hidden reality which has to be unveiled and deciphered can be found from Antiquity to present-day representations.

Nowadays, these representations of nature can survive through the cultural clichés used and reused by the media, to which neuroscientists and popularizers are exposed as much as ourselves. For instance, using the « black box » metaphor is something very common in the French newsmagazines.

« Black Box » metaphor in the French press

Le mystérieux contenu de la boîte crânienne. (<i>Le Point</i> , 2005.10.06)	The <u>mysterious</u> content of the <u>cranial</u> box
Les neurosciences analysent la “boîte noire” des 12-18 ans. (<i>Le Nouvel Observateur</i> , 2005.09.15)	Neurosciences analyse the teenagers’ « black box »
On est loin d'avoir sondé tous les mystères de la boîte noire. (<i>L'Express</i> , 2004.08.30)	One <u>is far from having probed</u> all the <u>mysteries</u> of the black box.

The scientific context

Kövecses writes that « if there are universal metaphors as « underlying » layer of cultural experience, some other metaphors may also be culture-specific. » Among others, « the subculture of science and its various subgroups provide an interesting example of how metaphorical source domains change over time. This is one of the most obvious cases of metaphor variation. » (Kövecses 2005). As a matter of fact, Cornelius Brock, in his study on the metaphors used in neuroscience, notes that « the brain appears to be an unstable organ that has been compared to a wide and variable range of objects » (Borck 2012) This instability could explain the gap between the media and the neuroscience field when it comes to brain metaphors. The media can keep on using metaphors that have proven inaccurate according to neuroscience. In our case, the popularizers of the SdC choose their metaphors in relation not in relation with the media, but in relation with the state of the art in neuroscience. Their terminology depends on what is considered legitimate in this specific field.

There can be of course common ground between media discourse and popularizers' discourse. For instance, the metaphors of the black box and the fortress keep on working, not only because of a general cultural context inherited from ancient past, but also because this ancient past is relevant to the history of brain science, in so far as this history, according to Nikolas Rose and Joelle Abi-Rached, is an history of the will of rendering the invisible visible or, in other terms, an history of the formation of a certain clinical gaze which strives to make visual the interior world of the human mind. (Rose and Abi-Rached 2013, see chap. 2)

In the majority of cases, SdC popularizers pay carefully attention to the scientific plausibility and the legitimacy of the metaphors, images, parallels, analogies, that they use.

What kind of scientifically legitimate metaphors are at the popularizers' disposal? According to Richard Boyd, you have basically two kinds of metaphors: pedagogical metaphors, which play a role in the teaching of explication of theories which already admit of nonmetaphorical formulations. (Boyd 1993, 485) And « theory-constitutive metaphors » which are used by scientists to express « theoretical claims for which no adequate literal paraphrase is known. » (id., 486). We can find them in young disciplines, for instance molecular biology in the first half of the 20th century (Keller 2004) or in computer science and cognitive psychology, from which Boyd quotes, among others, the example of the brain being termed as « a sort of « computer » » (Boyd 1993, 486)

This computer metaphor constitutes here an interesting case. At first, it is a theory-constitutive metaphor, with a story closely related to the development of neuroscience. As Cornelius Borck showed it, the computer has been « the most powerful brain model of the twentieth century », since Alan Turing's works and the interdisciplinary evolution of cybernetics after the end of World War II (Borck 2012).

This comparison then vanished by the end of the 1990's, to the benefit of other images such as neural networks or plasticity. This is why the computer metaphor is less and less used by the SdC popularizers, whereas it is still very popular in the media.

Another striking example is the highway metaphor that I mentioned before. This metaphor can be considered as a theory-constitutive one, which can be found in recent articles in *The Scientific American* and *Science*, related to the mapping of the circuit of the brain, which have been described as « a grid-like pattern of fibers crossing at right angles », « superhighways, (...) analog of the streets and avenues in New York City » (Mitra 2012) (Wedeen et al. 2012)

The popularizers' skills, capitals and positions

Beyond sociocultural and scientific contexts, the popularizers' performances depend also on more personal parameters such as skills, training and biographical trajectories, which make popularizers more or less comfortable with the use of metaphors.

Researchers usually want to be scientifically accurate and are rather sober in terms of metaphors. All of them use metaphors, without necessarily theorizing about it. They cling to the few controlled metaphors that I already mentioned. Of course, the longer they have popularized neuroscience, the better they can talk about popularization and its constraints.

Scientific mediators have a professional point of view on science popularization. Sometimes their lack of commitment in research may drive them to be less cautious in their choice of terminology, because their main purpose is to interest their audience. A less accurate message is

not a real problem. Flashy metaphors are welcome. They often are more innovative and may sometimes argue with scientists who may find their ideas a bit weird : using toys, models, plasticine, games and so on.

Another hypothesis is that the social position of the popularizers may also affect the way they engage in their activity and thus their recourse to metaphors. Depending on whether or not you are a researcher, whether or not you are at the beginning of your career, whether or not you are dominant, you may be more or less audacious, your metaphor may be more or less commonplace. The more you will be close to the research, the more you will tend to use accurate and therefore scarce metaphors. The more you will be a respected member of the scientific establishment, the less you will tend toward extravaganza.

Of course, this is a very general outline, and it has to be replaced in the context of a public event of science popularization, which deals above all with the public image of science.

An implicit representation of the audience

A final aspect of the question is the representation of the public among science popularizers.

The full understanding of the metaphors and analogies used by the SdC popularizers often requires some prior conceptual knowledge. If you compare the brain to a computer, you expect people to roughly know how a computer works. This is what Hugh Petrie and Rebecca Oshlag call interactive metaphors, in contrast to mere comparative ones (Petrie and Oshlag 1993).

Hence, we can talk of implicit representations of the public among the popularizers. These implicit representations can also be guessed via the use of the black box- or the fortress-metaphor. This kind of metaphor is likely to work for a certain kind of public that can share the same interest and curiosity for the brain secrets.

Sociological studies have established that, in France, this interest and curiosity spread mainly in certain social groups, mostly upper and middle class, mostly medical and social workers, teachers, human resources manager, etc. These results have been confirmed by a survey that I have made on the SdC audience in 2016. By saying this, I do not mean that popular neuroscience is only for educated people, but, in a more Bourdieusian approach, that this kind of science popularization is more likely to attract people with high cultural capital, and that this reality is implicitly taken into account by the science popularizers, who, by choosing their style of popularization, also choose or anticipate, somehow, a certain kind of audience.

Conclusion

If, according to Andreas Musolff, « Media discourse continuously makes creative and eclectic use of science terminology – often to the point of contradicting the views of scientific experts on the subject matter in question. » (Musolff 2007), this is, in my opinion, mainly due to the fact that the media discourses are mostly based on popular science, rather on scientific literature. Although they hardly could do otherwise, this can lead to more uncontrolled entailments than scientific popularization may have imagined at first. Anyway, it makes the study of the underlying metaphors in popular science all the more necessary.

We have seen that the importance of metaphors is due to cognitive reasons and that the content and significance of the metaphors in question are basically sociocultural. From that, one can conclude that a narratology of science popularization could draw a great benefit from the study of the social conditions of formation and use of metaphors.

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