Science in Media: cognition and emotion

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ABSTRACT: Making scientific content and research accessible, meaningful and relevant to readers through popularization strategies is highlighted in the study of cognitive-emotive interactions in discourses published in the media. The argumentative emotional features or "pathemes" that modulate scientific discourses are widely used in order to attract the target audience as well as to facilitate access to scientific knowledge. Such strategies and the interaction between emotion and cognition in discourse are thoroughly identified, studied and analyzed.

In this paper, we intend to re-define the popularization of science through media as a means of communication, highlighting thus the bond between cognition and emotion. This latter helps us to show the emotional orientation used in Scientific American magazine to transfer scientific information and to keep a wider range of readers. Nowadays, it is common that emotions accompany and carry information; they are also involved in the interpretation of the carried information. Thus, in the science in media context, the transmission of information takes place first at the emotional level, especially if the receivers do not feel concerned by the transmitted scientific information.

Science evolution is having a major impact on our societies. In this concern, it is necessary to define some basic points of reference that would reassure citizens and lead to their adaptation. It is about helping them to understand their environment by transmitting as much information as possible, thereby contributing to the development of collective mentalities. People have a keen interest in those sciences that affect their daily life, particularly medicine, biotechnology and environmental science. For its part, the media reserves a place for science in order to satisfy the public amateur, and to involve and stimulate those who are indifferent to any progress or any concern. It seeks to prove that as a source of information, it forms an express-network of knowledge transmission, and a force that has its place in democratic communication and maybe in the decision-making process. The media thus highlights the problems of society in which science is heavily involved and implicated. This globalization of scientific information has pushed discourse experts to look again at the concept of "style" in scientific discourse. The style in question here is the one that speaks to the mind through emotions, that arouses laypersons' and experts' curiosity at the same time and promotes research, reading, understanding and action, i.e. activities that require some cognitive contribution. In this regard, it is interesting to consider the interaction between emotion and cognition[1] which purpose would be to succeed in transmitting and acquiring knowledge, including scientific information.

1. SCIENCE POPULARIZATION VS. SCIENCE IN MEDIA

The media reports all kinds of events that are likely to affect public opinion, to create controversy and to arouse a certain emotionality directed towards an action or a position; they engender some of the emotions experienced in everyday life. If unfamiliar situations can call up emotions (affection, pity, fear, etc.), what would we say about tackling in discourse certain subjects (cancer, genetic manipulation, asbestos, contaminated blood, etc.) that closely affect the life (or survival) of individuals and refer to common experiences?

1. This study uses the word "emotion" as a generic term for "emotion, affect, experience, state of mind, mood and feeling", while some authors distinguish between different affective dispositions. Likewise, the words "cognition, cognitive activity and cognitive process" will not be differentiated in this work.

If people show great interest in the sciences that deal with health, biological variations and their effects on human body, they nevertheless seem influenced by emotions, knowing that they encounter difficulties in understanding technical cognitive contents. To remedy this, medical science, which is progressing continuously, highlights the achievements contributing to the welfare of societies. These achievements arising from a social need are a basis for communication between specialists and the public. Such a communication – provided by the popularization process and questioned by media coverage – is today less about transmitting knowledge than about "organizing the coexistence among more or less competing and conflicting logics" (D. Wolton, 1997: 11).[2]

Indeed, the two practices in question are different in terms of intended targets and strategies of presenting scientific information. Centered on transmitting knowledge, popularization would consist of transposing and reframing medical jargon into everyday language through discourse techniques such as reformulation, paraphrasing or analogy. As for the media coverage, it links the facts of science to their impact on society. It addresses the public and uses the dramatization and demonstration of facts. In this context, medical information becomes a subject of discourse and scientific objectivity gives way to explicit media involvement. Moreover, the mediator/journalist does not appear directly as the enunciator of the discourse. He compares contradictory notions and shares the perspectives of experts and the views of scientific institutions. His participation appears only when he discloses fault or error cases.

Science popularization is often seen as an extension for education. It facilitates the access to specialized information with the pleasure of knowing and the freedom of choosing, which are not always provided through the education process. It maintains social balance and aims at creating an informed public, able to take part in controlling the power of science through a minimal relation to knowledge. It is a discourse on science, which draws attention to scientific progress and controversies. The transmitted knowledge is not deeply influenced by ideology, social conflict or political position. As for science in media, the latter turns popularization discourse into a cause and effect assessment in a spectacular and dramatic setting and attracts

2. Our translation of the following original text in French: «organiser la cohabitation entre des logiques plus ou moins concurrentes et conflictuelles».

audience as if by magic. However, both operations converge in a way as they stem from the will to transmit knowledge and the availability of a means of communication. Their rhetoric displays a mixture of scientific terms, definitions and analogies, woven into a narrative, subjective and metaphoric framework.

Furthermore, popularization and science in media have a common purpose. They aim to transmit scientific information, as accurately as possible, to a general audience. However, if popularization causes a fragmentation of knowledge and a loss of content, which can sometimes be tolerated, media coverage is a risk factor for information deficit that leads to a much greater loss. In this regard, Marie-Noële Sicard (1997: 150) argues, "the media framing that isolates a fragment, hypertrophies and separates it from its context, makes the overall vision of a situation evasive".[3] Thus, the resulting setting helps in building new links that may confuse the reader, leading him to wrong conclusions.

2. SCIENCE POPULARIZATION: CONTINUITY IN COMMUNICATION

Nowadays, scientific activities are bound to economic policies, and are progressively losing their objectivity. In these circumstances, controversies are subject to evaluations based on scientific or economic interests. In this competition, mediation has its role and mediators are the media. It has its own concept of information and tends "to prefer a scientific scandal over a daily explanatory long-term work" (D. Wolton, 1997: 10).[4] Therefore, communication is suspected of disfiguring scientific truth in order to manipulate its addressees, to create controversies or to lead a debate. This is how the media participates in the evaluation of scientific activities.

As for the evolution of science popularization, the communication model called "the third man" reduces the number of actors concerned with the process[5] and simplifies the elements involved in transmitting knowledge. However, it does not include communicational development. Similarly, the nature of the questions arising today has changed. Earlier works (P. Roqueplo 1974) are interested in popularization's capacity of transmitting scientific knowledge and thus, in its educational limits. Today, on the other hand, the stakes regarding the dissemination

3. Our translation of the following original text in French: «le cadrage médiatique qui isole un fragment, l'hypertrophie et le sépare de son contexte rend insaisissable la vision d'ensemble d'une situation».

4. Our translation of the following original text in French: «préférer un scandale scientifique au travail patient d'explication au jour le jour».

5. The protagonists are three and they all have a role in the field of popularization. The rupture theory implies that scientists withdraw into their jargon and refuse to participate in popularization. The public is still deemed as amateur and/or non-specialist. Therefore, the mediator is a necessity justified by the gap between the first two actors in communication. Such a communication possibility does not exist according to the rupture theory.

of science have changed; the media that convey scientific information does not aim at teaching or transmitting rigorous science, which directs us more towards the theory of continuity. The latter recognizes that popularization is the most important communication channel used by the scientific community. In other words, it is "analyzed as an aspect of the social dissemination of knowledge in what is commonly called the scientific field" (D. Jacobi, 1984).[6] Therefore, there would be continuity between the primary texts produced by specialists and those published by popular magazines. The distance between the presentation strategies used by peers and popularization's analogical methods would not be as important as believed.

This study does not address popularization only as part of the scientific field but also as a media component, which does not prevent us from supporting the theory of continuity.[7] However, the influences that popularization undergoes in the media field should be taken into consideration, namely the implementation of communicational standards governing the production of media messages. If we reconsider the process while taking into account the aspects of communication, we will conclude that complexity goes beyond the message, i.e. the production and the diffusion of information, and reaches its reception involving relationship and otherness issues. Communication would be used to manage the differences between individuals or systems, especially when today's information become endless while dealing with an audience that is increasingly multiple. The interaction between the addresser of the message and the addressee shows the latter as the key player in the communication indulged in speaking, criticizing, accepting or refusing information as and when s/he acquires knowledge. However, making contact with others is essential. D. Wolton (2009) identifies three factors leading to communication in general, easily found in the popularized scientific discourse. The first is sharing. Communication by definition means an exchange between two parties for different reasons. The second is seduction, which is present and active in social relations. The third factor is persuasion, which uses the argumentation to respond to objections and to achieve the goal of communication.

6. Our translation of the following original text in French: «[elle] est analysée comme facette de la socio-diffusion des connaissances au sein de ce qu'il est convenu de désigner comme le champ scientifique».

7. The theory of continuity is not deeply concerned by the effective study of popularization discourse in media.

In the media framework, communication has two main targets: information and captivation (P. Charaudeau 1994). These targets are perfectly reached in the popularized discourse. On one hand, it establishes communication between two distinct communities, and on the other, it borrows widely used and accessible means of communication. The discourse strategies and devices employed to seduce the minds and attract readers (P. Laszlo, 1993) are aimed at reaching the target audience "making them feel emotions and even unconscious impulses, all that is on the antipodes of rationality which underlies the information" (P. Charaudeau 1994: 13).[8] Therefore, popularization faces two constraints, that of the "know-how" and the other of the "do-feel".

8. Our translation of the following original text in French: «en lui faisant ressentir des émotions, voire des pulsions inconscientes, toutes choses qui se trouvent aux antipodes de la rationalité qui sous-tendrait la visée d'information».

3. SCIENCE POPULARIZATION: CAPTIVATING TO INFORM

As soon as mediators undertake the popularization tasks, they start acting in a scientific communication context, ruled by the addressees needs, enabling them to choose writing and display strategies, different from those of primary publications. In a specialized scientific discourse, natural, formal and graphical languages complete each other. Only specialists can decode the result. The popularizer strives to develop into discourse and in a natural language, the formal and graphical content. S/he is responsible for transmitting knowledge, its diffusion being not enough. For this purpose, s/he inserts subjectivity in the specialized discourse, s/he interacts, chooses the tone, the form and the terms that facilitate transmitting the message to the audience. S/he must make science more accessible. An eloquent rhetoric that uses images, explanations, and parallelisms with real life can be the key. Social discursive criteria that are likely to reach the feelings of the audience guide the production and display of information. The addressees will build up an opinion or assess the reported facts according to the feeling they get when they receive the information.

However, as Joseph Leif stated (1982: 10), this approach is tricky. "The transfer and identification" caused by the discourse "often provoke attachment"; the journalist becomes a model for the audience who agrees to be caught up in the game because emotions dominate the thought

often and by nature (by necessity, fear, ignorance, etc.). Moreover, media discourses are dynamic and playful. Their purpose would be to engage the audience in the game. Entertainment is a way to bypass the difficulties and render the message more attractive. Similarly, the obvious repetitions in the diffusion process, participate deliberately in the game of manipulation.[9] On this subject, P. Breton (2000: 94) explains that repetitions transform strange and unfounded issues into acceptable and normal ones. The author adds that an opinion becomes acceptable when it is associated with an element that is already accepted by the audience. As such, the objective scientific information, independent of the discourse enunciation situation, is mixed with a point of view, an opinion, political, economic and social arguments that fit the scientific content and model the esoteric knowledge in order to serve a cause or to dismantle another.

9. We define the act of manipulation, as any binding, emotional or cognitive action, misleading and depriving of freedom those who are subject to it.

4. THE INTERACTION BETWEEN EMOTION AND COGNITION

Recent studies and debates[10] point to the existence of a cognitive component in emotions and examine the link between cognitive and emotional systems. Some theories highlight the fact that cognition is an integral part of the emotional experience. It handles emotional reactions (or corrects them) and is influenced by the social environment of the person. This influence reminds us of the assumptions related to cognitivism stressing that individuals analyze the data they receive according to their life experiences and expectations. Their emotional reactions might be faster than the conscious cognitive ones, but this does not mean that the unconscious cognitive processes that were activated prior to the understanding process are inexistent. Following the example of R. Dantzer (2002: 11), we say that emotions arouse from the interpretation of a situation and not from the situation itself. This interpretation leads to an estimation of its consequences. In other words, the personal interpretation of stimuli determines the emotion through the cognitive assessment. This theory of R. Lazarus (1984) seems to inspire the recent literature; it concedes that the type and the intensity of an emotion depend on the outcome of the cognitive assessment process, which can be fast, automatic, unconscious or controlled.

10. R. Dantzer 2002, V. Christophe 1998.

Cognition is not then solely a matter of reason. This premise is reinforced by the experiments of A. Damasio (1995) who demonstrates that when the body and the emotions are dissociated from the cognition, no learning or rational behavior occurs. His experiments showed that three elements are required to learn or memorize data: a sensory perception, a personal emotional association and an action. Ultimately, recent developments in neuroscience have attributed an importance to emotions relatively equal to that of the reason, allowing a strong comeback of emotion issues on the intellectual scene. P. Livet (2002: 23) even defines emotion as "an extension of our thoughts". Furthermore, recent studies show that emotions can facilitate some cognitive mechanisms such as attention, perception, information processing, decision--making, memory or value judgment. This interaction has been studied at the schematic level (H. Leventhal 1987, G. Bower 1981) and analyzed through appraisal theories largely developed by many specialists, namely Nico Frijda (2003).

The author (2003: 15) argues that emotions act on thinking in many ways, "stimulating or preventing cognitive development, creating and setting beliefs, determining the acceptance or the rejection of information".[11] Combining intentionality and functionalism, he sees emotions as modes of readiness to act in response to a cognitive trigger factor, because cognition is both a constitutive and a causal element of the emotional experience. However, a situation cannot induce an emotion unless it involves an expectation, a goal, a need, or in other words personal, relational or social "interests". The satisfaction of these interests – or the lack thereof – induces emotions; their intensity is directly related to the strength of interests. Therefore, the evaluation and the interpretation of an event would be trigger factors of emotions and this is due to a confrontation of the person's emotional and cognitive abilities.

11. Our translation of the following original text in French: «suscitant ou réfrénant l'élaboration cognitive, créant et fixant des croyances, déterminant l'acceptation ou le rejet d'information».

5. COMMUNICATION THROUGH EMOTIONS

The success (or failure) of science popularization as a means to transmit specialized knowledge in a common language is directly related to the act of communication that underlies it. To communicate is to produce and to interpret clues. Therefore, a sentence with a single semantic

representation may express different thoughts. To interpret the statement and understand the thought, the audience relies on the context of communication that consists of a set of hypotheses emerging from the social environment, beliefs, memories, cultural prejudices and previous statements. Nevertheless, the composition of a context differs from a person to another, even if their language skills converge and they share a number of experiences.[12] For a good interpretation of the addresser's thought, it would be useful to exploit the "mutual knowledge" of the two parties. When communicating via science popularization, this mutual knowledge is represented by emotions, as the mediators wrap scientific concepts in rhetorical ornaments that trigger emotions to reach the readers. In fact, universal emotions felt or created by the sender, accompany the information and are sources of information themselves allowing the reader to interpret and understand the message. This situation is pretty close to the "mean to say" one (vouloir-dire), whereby a subject produces an utterance holding a specific meaning, chooses intentionally his words and attempts to create an effect and touch the addressees who recognize the hidden intention.

Accordingly, when transmitting scientific information, the complexity in concepts and language pushes the popularizer to produce the discourse and choose its orientation with the intention of resolving the difficulties. For the reader, the problem is solved once he builds a mental model uniting all the information provided by the mediator and included in the text. Nevertheless, as specified by G. Denhière and D. Legros (1983: 19) "the meaning is not in the text, it is in the minds of the persons"[13] which in the presence of a stimulus, engage in psychological activities combining the knowledge saved in their long-term memory. Indeed, information with no prior knowledge is irrelevant and is not processed by the cognitive system. Memory, as we know, is a network of nodes consisting of simultaneously activated concepts and emotions in the presence of stimuli. We also know that rhetoric is partially inspired by affectivity.[14] Thus, the use of rhetoric to explain the science creates a contact in the mind of the addressee between a memory of an emotion and new knowledge. In other words, emotions inductor data is retrieved from long-term memory; it is then associated with new information to become a representation processed by the work memory.

12. Humans do not all build the same mental representations because of differences in their local physical environments and their cognitive abilities (D. Sperber & D. Wilson, 1989: 65).

13. Our translation of the following original text in French: «la signification ne réside pas dans *le texte*, elle est dans la tête des individus».

14. Refer to Chaïm Perelman & al. (2008). *Traité de l'argumentation: la nouvelle rhétorique*. Brussels University.

6. SCIENCE IN MEDIA: EXPRESSIVE LANGUAGE AND EMOTIONAL THINKING

The mobilization of emotions provided by the language aims at two different purposes in the context of communication through popularization. On one hand, it takes part in the treatment of scientific information deemed inaccessible to a non-scientific audience by facilitating the development of a conceptual representation of information. On the other hand, it guides the interpretation of the events recounted in the popularized discourse leading to a position taking. The language is likely to express and provoke emotions. To this end, linguistics proposes through stylistics language devices that are potential vectors of affectivity, in addition to the tropes and figures of speech that enrich the language of the imagination and passions. These criteria do not form a linguistic system of emotions as they belong to different levels identified in language sciences. However, "they may add an emotion color to statements".[15]

To make it clear, we have examined different articles that were published in the Scientific American magazine printed or uploaded on the Internet between 2000 and 2008, about genetics, cloning and GMOs. We noticed a frequent use of idioms and intensives. The discourse refers to emotions through a vocabulary characterized by its affective meaning. Syntactically, the use of highlighting and inversions is obvious. In the table below, we share some examples of our finding:[16]

Language Device	**Example**[17]
Emotional Lexicon	Despite evidence of two-way cellular traffic between mother and fetus, biologists were surprised in the 1990s when they learned that small numbers of the foreign cells often survive indefinitely in healthy individuals. (February 2008)
	Worries about the flow of genes from the original plant to others also surround GM crops. (April 2001)
	In 1998, a Swiss study provoked widespread worry that Bt plants can inadvertently harm unlucky creatures. (April 2001)

15. Our translation of the following original text in French : «ils servent à ajouter une couleur d'émotion aux énoncés» (C. Plantin, 2003 :107).

16. For ergonomic reasons, we did not include complete references (magazine issue number, titles of articles and page numbering) in the body of the text; this information can be delivered upon request. Note that the original texts may contain grammatical or spelling errors that we have not corrected.

17. The author of this paper underlined the examples to make them easy to read.

Idioms	Successes with this approach are still very much hit-or-miss. (July 2006)
	We need to fish or cut bait. (April 2001)
	Genetic engineering has a place and should not be taken off the table. (April 2001)
	The presence of a mother's cell in her off-spring is probably a double-edged sword. (February 2008)
	That was the straw that broke the camel's back. (April 2001)
Intensives	The number of hungry people in the world remains stubbornly high. (September 2007)
	And the Y is riddled with unusually high amounts of "junk" DNA: sequences of code letters, or nucleotides, that contain no instructions for making useful molecules. (February 2001)
	This situation is worrisome not only for the places that lack health care but for the entire world. (September 2000)

"Mise en relief" (Highlights)	This one molecule can carry both the genotype (the genetic sequence information) of an organism and the phenotype (catalytic functions). (December 2008)
	The term "entry" actually covers a few steps, beginning with the binding of the virus to some docking site, or receptor on a host cell and ending with "uncoating" inside the cell; during uncoating, the protein capsule (capsid) breaks up, releasing the virus's genes. (November 2001)
	Sharp, a co-winner of the 1993 Nobel Prize in Physiology or Medicine was referring to a series of relatively recent discoveries that cells have a mechanism, dubbed RNA interference (RNAi), which blocks gene expression. (September 2004)
	A dark side of stem cells – their potential to turn malignant – is at the root of a handful of cancers and may be the cause of many more. Eliminating the disease could depend on tracking down and destroying these elusive killer cells. (July 2006)
Inversions	That cells cross the placenta is not surprising. After all, the tissue that connects mother and child is not impenetrable barricade. (February 2008)
	To demonstrate the power of the fab approach and to seed this new field, the M.I.T. group offered the first course in fab-style engineering with biological parts in 2003. (June 2006)

Examples of the use of language devices in Scientific American popularized discourse

In these texts, the addresser's presence is confirmed through voices that model the discourse, warnings and questions, and in the use of structures introducing a repetition (reprise), an explanation or a reformulation. According to P. Charaudeau (2008: 21), this use shows that the speaker is "aware of the gap between the scientific language and the understanding of popular audience".[18]

Examples:

Can a totally alien, PNA-based life-form be created in the lab? (December 2008)

Are they advertising cutting-edge science high-tech gold horoscope? (December 2007)

What in the world do these foreigners do in the body? (February 2008)

Discourse pathemization is ensured, among other things, through respecting the communication contract subject to various constraints including that of emotionality expressed by devices that favor pathemic affective effects.[19] In light of this, the illustrated headlines guarantee visibility and capture the attention of readers; the tropes invigorate the discourse and allow readers to associate a thought to an illustration.

6.1. ILLUSTRATED HEADLINES

Assuming that every reading starts with the title, the interpretation of the latter enables one to anticipate the content. If it primarily indicates content, it also aims at enhancing it. It provides the first contact between the text and the readers, inviting them to an imaginary space, to a universe of representations. It holds the readers' attention through a double referential and conative function. Thus, it refers to the information content of the text and intends to seduce and convince readers (poetic function). The emotional organization of popularized articles begins with headlines. The titles orientation is easily detectable. They are synonyms for hope, revelations, inquiries, challenges, etc. Some headline categories are privileged in the Scientific American:

18. Our translation of the following original text in French : «conscient de l'écart qui existe entre le langage scientifique et la compréhension d'un public tout venant».

19. The discourse is subject to other types of constraints such as visibility, readability and reliability. The producer selects the unusual scientific facts affecting the social life. Visibility is provided through the illustrations and titles. The simplicity and the figurability mark the popularized discourse: a simple sentence structure, a clear and transparent lexicon, script-to-visual processes, etc. The reliable content is apparent in iconography (tables, diagrams, photos), discourse organization methods (descriptive, explanatory), anaphoric references and the use of quotation marks and metalinguistic structures. It is also expressed by mentioning scientific references to produce a scientific effect (P. Charaudeau, 2008: 20-22).

a. Important discoveries. Examples:

- The First Human Cloned Embryo (11/2001)
- The Real Life of Pseudogenes (08/2006)
- Mother of All Cells (07/2005)

b. Achievement and success. Examples:

- The Stem Cell Challenge (06/2004)
- Seeking the Connections : Alcoholism and our genes (04/2007)
- Hitting the Genetic Off Switch (09/2004)

c. Threat. Examples:

- The Risks on the Table (04/2001)
- Seeds of Concern (04/2001)

d. Doubt and questioning. Examples:

- Stem Cells : The Real Culprits in Cancer? (07/2006)
- GM Foods : Are They Safe ? (04/2001)

e. Hope. Examples:

- The Promise of the Mother Cell (12/2006)
- The Bio-Informatics Gold Rush (07/2000)
- A New Molecule of Life (12/2008)

f. Anthropomorphism. Examples:

- Diet Advice from DNA (12/2007)
- Bringing DNA Computers to Life (05/2006)

The interrogative sentence that usually characterizes the scientific approaches (question / answer), has a significant position in the headlines. It reminds somehow of the science and is at the same time an enunciative promise. When passing from the interrogative title to the text, the reader expects to find an answer to the asked question.

Examples:

- Does the World Need GM Foods? NO (04/2001)
- Does the World Need GM Foods? YES (04/2001)
- Why the Y Is So Weird? (02/2001)
- Lovers, Not Fighters? (02/2008)

The title has also a provocative function that allows it to play its role of seducer. It weaves illusions (interpreted by the reader) betting on the text to take over and reactivate the same universe of representations. It seduces the reader through signs that suit them. It thus constitutes a psychological and social phenomenon and participates in the media persuasion game.

6.2 IMAGE METAPHORS[20]

Image metaphors[21] (living metaphors, analogies, comparisons) have certainly a special place in the discourse. Their frequent presence in the texts is intended to surprise, kindle the reader, inform him that the text is codified and that he's familiar with those codes (Marc Lits, 2008: 169). Thus, comparisons facilitate the understanding and the retention of information while metaphors, more common in popular texts, color the discourse and attract the reader with images. Despite the recurrent use of comparisons and analogies that contribute to the captivation and appropriation of information as good as metaphors, we chose to focus on the latter because of its particular functions in the popularized scientific discourse.

Many agree that the metaphor in all its aspects – living, dead, lexicalized, creative, etc. – participates in the organization of ordinary and specialized discourse. It has the ability to reorga-

20. A type of metaphors "that maps conventional mental images onto other conventional mental images by virtue of their internal structure". (G. Lakoff, 1987: 219).

21. The metaphor, analogy and comparison have separate approaches. However, in the extension of Aristotle view of metaphor, it can indicate all resemblance images. Note also that the analogical reasoning, which means that the analogy is part of the other two images, supports the comparison and metaphor.

nize knowledge. It adds information to those already acquired and creates connections among data. It can explain a phenomenon by turning what is strange into familiar representation through analogies. This is how it serves the popularized discourse. In this particular case, it does not only play an ornamental role, but also has a cognitive function that aids in the explanation and modeling of sciences. Its vocation to clarify scientific statements with a didactic aim is particularly interesting. Consequently, we do not retain here but the discourse images created in a given context excluding lexicalized terms and frozen metaphors. The use of this trope in popularized discourse is intentional; it strikes a balance between emotional (connotative) and referential (denotative) structures. It aims primarily at attracting readers: metaphors give tangibility to subjects that a non-scientific might consider unattractive.

	Examples
Comparisons:	- I sometimes think of the transferred stem cells or stemlike cells as seeds sprinkled through the body that ultimately take root and become part of the landscape. (02/2008) - And yet from a computational standpoint, our automaton still seemed like a self-propelled scooter compared with the Rolls-Royce of computers on which we had set our sights: the biomolecular Turing machine. (05/2006) - The other 22 sets of chromosomes in our cells consist of well-matched partners, as alike as twin candlesticks. (04/2007)

Metaphors:	- Instead of being the Rodney Dangerfield of chromosomes (as some have called the chronically disrespected Y), the male chromosome is actually more like Woody Allen: despite its unassuming veneer, it wields unexpected power. (02/2001) - Pairs of these bases joined by hydrogen bonds form the "rungs" of the familiar DNA "ladder". (12/2008) - Potatoes are ideal in many ways because they can be propagated from "eyes" and can be stored for long periods without refrigeration. (09/2000) - On the negative side, maternal cells may contribute to diseases typically classified as autoimmune, meaning that the immune system unleashes its fire against the body's own tissues. (02/2008) - It mobilizes its various forces to root out and destroy the apparent invader – targeting the campaign to specific antigens (proteins recognized as foreign). The acute response soon abates, but it leaves behind sentries, known as "memory" cells, that remain on alert, ready to unleash whole armies of defenders if the real pathogen ever finds its way into the body. (09/2000) - Our genetic closet holds skeletons. The bones of long-dead genes – known as pseudogenes – litter our chromosomes (08/2006)

Examples of metaphors and comparisons

6.3. THE METAPHORICAL CONCEPTUALIZATION IN THE POPULARIZED SCIENTIFIC DISCOURSE

Metaphors are recurrent and essential for the understanding of the conceptualization applied to the field we are examining here, which has quickly set its major consequences on medicine. The conceptual metaphors reflect the way science is modeled. The meaning is built when two cognitive configurations (fictitious and factive/causative) are combined: "The conceptual metaphor reflects a thought process in which a mental representation is apprehended through another identified representation" (S. Vandaele, 2005: 277).[22]

Thought processes such as conceptual images are integrated in the "reference act" that is the discourse and without it, the images cannot perform. If the correspondence with potential reference points is not taken into consideration, understanding cannot occur. For example, in the sentence "The imprinting program is generally reset during embryonic development" (11/2001), the term "reset" belonging to the computer programming and electricity domain, means a back to the initial state or a reboot of settings. In genetics, this term refers to a reinitialization of DNA fingerprinting program.

In the texts we examined, some expressions indicate that the molecules involved in pathophysiological processes are conceptualized as if they were characters of a script. For example, in the statement "a model of molecules capable of reading the DNA sequence" (12/2008), the chosen conceptualization mode is the following: the molecules have a cognitive faculty. They read, transcribe, translate, etc.

At last, some conceptual reference points on genetics identified in the Scientific American are presented below. An example per reference is provided in this paper to avoid its saturation.

22. Our translation of the following original text in French : «La métaphore conceptuelle témoigne d'un processus de pensée grâce auquel une représentation mentale est appréhendée à l'aide d'une autre représentation déjà connue».

Reference point	Example
Mythology	CHIMERA in mythology combines parts of different animals – a lion, a goat and a snake. A person who harbors the cells of another person is said to be micro-chimeric because relatively few cells are involved. (02/2008)
Cinema	Plastics. When a family friend whispered this word to Dustin Hoffman's character in 1967 film The Graduate, he was advocating not just a novel career but an entirely different way of life. If that movie were made today, in the age of the deciphering of the human genome, the magic word might well be "bioinformatics". (07/2000)
Family	Crops that provide the majority of their food supply and livelihoods – rice and wheat – are being neglected, as are a variety of "orphan crops". (09/2007)
Anthropomorphism	Those [the genes] responsible for basic cellular housekeeping functions. (08/2006)
Language	But the molecules do have a unique ability; they speak the language of living cells. (05/2006)
Time	The cloning process also appears to reset the "aging clock" in cloned cells. (11/2001)

Programming	Tightly controlled by their own genetic programming in concert with signals (07/2006)
Machinery	If individual transistors are the basic components of electronic circuits, then their biological equivalents are genes: long, carefully ordered stretches of DNA. To construct genetic circuits for advanced biological devices, therefore, we need a way to manufacture long pieces of DNA quickly, reliably and at a reasonable price. (06/2006)
War	If acquired cells are attackers, they could be selectively pinpointed for removal or inhibition. If they are targets of attack, strategies that induce the immune system to tolerate them could be developed. (02/2008)
Nature	Thus, rather than the genomes of humans and other complex organisms being viewed as oases of protein-coding sequences in a desert of junk, they might better be seen as islands of protein-component information in a sea of regulatory information, most of which is conveyed by RNA. (10/2004).
Port Area	beginning with the binding of the virus to some docking site (11/2001)

Conceptual reference points on genetics in the Scientific American

In conclusion, it would be pertinent at this point to recall the aims of the popularized scientific discourse as studied in this paper, namely information and captivation through the expressive devices (the pathemization), and to put emphasis on the functionality of the seduction strategies chosen to disseminate science in media. Obviously, expressive language reveals the pathemic intent and shows its potential strength. It is true that discourse markers contribute to the linguistic expressiveness but they may not be enough to trigger a pathemic effect. Actually, these devices cannot communicate a particular emotion or provide a semantic specification. However, they indicate an overall emotional dimension. Adding other elements with emotional potentials is therefore necessary to produce an effect such as referring to highly emotional situations (souvenirs), warning of impending danger, tampering with the beliefs and traditions, or announcing a happy event, an unexpected success.

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