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The Role of Illustrations in Popularizing Medical Discourse

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1. INTRODUCTION

The growing importance of scientific phenomena and data in the media has more and more caught the attention of specialists from different disciplines with regard to how scientific information is spread in scientific and specialized publications, as well as in publications addressed to laypeople. In particular, in passing from a specialized audience to a non-expert one, scientific magazines play a crucial role: the journalists therein act as mediators between the scientific information and the popularized content which should become accessible to non-expert readers. They should choose forms of expression that they consider maximally transparent for other participants, but their message, although theoretically easily understandable, could be marked by power differences (Kress and van Leewen 2006). As a consequence, this interpretation requires a stronger effort on the part of the readers, who do not always share the same knowledge as the author. Hence, it is important for journalists not only to use understandable language, where strategies of paraphrasing and of reformulation are essential, but also to try to attract potential readers' attention through visual tools. These data can take different forms and deal with different phenomena. In this paper, attention will be focused on illustrations in articles of popularizing scientific magazines [1]. In general, this semiotic "mode", as well as the strategies of reformulation or of paraphrasing, add supplementary and often non-scientific information to the main text so as to explicate it and to render it more acces-

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[1] A preliminary study has dealt with a wider research on the role of images and captions in the popularizing medical discourse by Silvia Cavalieri and myself. The present article specifically investigates the role of illustrations, although further research by Silvia Cavalieri will concern the role of captions. Hence, the same corpus will be used for both researches.

sible to a wider audience (Reboul-Touré 2002). Thus, illustrations will be seen as a strategy of paraphrasing, in which some information is replaced by other semiotic information which refers to the main scientific content.

Nowadays, illustrations permeate many scientific domains, but they are mostly exploited in medical discourse. This is due to the interest of the media and of laypeople looking for an immediate application of phenomena which could be linked to their health. Or, it can be driven by the international media attention usually given to viruses, illnesses or epidemics.

As a consequence, this study will analyse the role of illustrations in the discourse of medicine through the media, in particular the online versions of American, French and Italian magazines of science popularization as far as the medicine section is concerned. It will highlight the importance of this type of visual data, as well as its usefulness and contribution to text understanding. Finally, some remarks will emerge from the comparison between the magazines, per type and per language.

The methodology adopted for the analysis of the illustrations in popularizing medical discourse texts is multimodal. It will be based on socioterminology (Gaudin 2003), since scientific concepts and terminology, thanks to the illustrations, are inserted into a social context, on social semiotics and on multimodality (Kress and van Leewen 2006; Baldry and Thibault 2006), whereas a semiotic Peircean classification (Fisette 2009; Lathene-Da Cunha 2013) will be used to distinguish the different types of illustrations.

2. ILLUSTRATIONS AND THEIR USE IN SCIENCE

Our theoretical framework is based on social semiotics and on multimodality, whose key element is the sign in all its forms (Van Leeuwen 2005). In a multimodal approach, the analysis of communication is concerned with texts that combine two or more semiotic resources. According to this perspective, meaning-making of a multimodal text depends on the interplay of these resources, namely on co-contextualization (Baldry and Thibault 2006) of the meaning potential of a material semiotic artefact, of the social and cultural environment, and of people's intentions and knowledge. Multimodality, in fact, does not replace traditional elements observed in text analysis, but it combines them in a new dimension, as it emphasizes social context, meaning making and people's involvement and choice of resources (Jewitt 2008). For the present research, we will apply these remarks to the image-text relation and, more generally, to the paratextual material accompanying the text.

Within the context of science, it is possible to define illustrations, according to Bontems (2013), as non-textual forms which can be useful for

scientific data interpretation and for building knowledge. In primary texts of science, such as research articles published in scientific magazines, produced by a specialist and addressed to other specialists of the same or of similar domains, illustrations are aimed at visualizing, observing and understanding a scientific phenomenon presented in the written text. In popularizing scientific discourse, however, they play an additional particular role. As the popularization of scientific discourse is a mediated discourse, which originates from primary scientific discourse and is legitimated through reference to this source (Dondero 2013), its primary addressee is not a specialist, but the public at large, "le grand public" (Jacobi 1999). Not only the addressee but also the text's author and its aim change. In science popularization magazines, the journalist has the difficult task of reformulating the scientific specialized knowledge into a more comprehensible language. He will use linguistic and discursive strategies to allow potential readers to understand the scientific content, but also, as the scientific text is a pluricode discourse (Pétroff 1984; Miller 1998), illustrations.

Within the media, visual material is produced according to readers' understanding and sensitivity. In this domain, illustrations have multiple functions and present different features. It is difficult for the journalist-popularizer to use the same technical illustrations that can be found in the primary scientific text. If this were the case, they would suffer a sort of lack of scientific reference, since they are adapted to the supposed empirical evidences of their public (Bontems 2013). Furthermore, because the aim of a popularizing journalist, besides enabling laypeople to engage with the scientific content, consists in attracting readers' attention, the illustrations contained in popularizing scientific magazines frequently show a "spectacularization" of the news (Moirand 2005). Hence, the choice of the illustrations is often carried out according to their influence on readers' sensitivity (Barthes 1993). This feature is a characteristic of all types of popularizing texts, but in particular the medical ones. Popularized articles on viruses, illnesses or pandemics are a striking example. In addition, as texts of popularizing scientific magazines are secondary if compared to their primary source, the use of illustrations may represent a way for the journalist to legitimate his/her own discourse. It is what the remaining part of this article will show on the basis of the corpus analysis.

3. THE CORPUS

The corpus of this study belongs to scientific (semi) popularization discourse, according to the distinction made by Casalmiglia and Van Dijk (2004) and by Desmet (2005) concerning different scientific publications. These authors

infer that this type of discourse may be found in popular scientific magazines characterized by the intention of disseminating general scientific information among the public at large. This target audience is represented by laymen interested in the latest news in science, filtered through scientific magazines of popularization, which adapt them to the editorial board policies. As a result, these texts rely on acquired scientific knowledge and are intended to create new general popularized knowledge (Lathene-Da Cunha 2013). This is the reason why their authors are journalists whose language and scientific content have to be adapted to popularization. These texts generally have an average length varying from 250 to 1000 tokens. They also contain a huge number of photographs and images as a supplementary way to attract readers' attention and to enhance their comprehension of the scientific data presented in the texts. Finally, the evolution of the web has produced enormous masses of textual resources often easily accessible. In the case of scientific texts, they generally belong to web multidisciplinary databases, such as the online versions of popular scientific magazines. In addition, the web also offers the possibility of collecting texts written in different languages. This reflects not only differences in terminology, but also allows the readers to perceive different cultural behaviours, for example.

According to Sinclair (1996, 5), a web corpus is "a corpus which is encoded in a standardised and homogenous way for open-ended retrieval tasks". This definition highlights the multiple possibilities offered by this tool, which can be enhanced if the corpus relies on different languages. Our corpus is a comparative one: it deals with three languages – (American-)English, French and Italian – and its texts are similar in genre and in subject but are not mutual translations of each other. These texts come from the medicine sections of six popular scientific magazines in their web editions. Two of these magazines are American, that is, *Scientific American* and *ScienceDaily*, two are French, *Futura-Sciences* and *Sciences et avenir*, whereas the last two are Italian, *Le Scienze* and *Focus*. The time span covered by the texts goes from the 1st to 31st October, 2013. The choice of this corpus has been driven by its aim: the study of illustrations contained in these texts to show the relationship between written text and illustrations, and the type of illustrations selected by the journalists. If *Futura-Sciences* clearly states its intention to mediate and to discover science through the texts it publishes (its slogan is "[L]e magazine de l'innovation, de la science et de la découverte.Le savoir s'invite chez vous" [2] (www.futura-sciences.fr), other magazines show the intention to create a relationship of trust with their potential public. This is the case with *Scientific American*, which offers the

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[2] The magazine of innovation, of science and of discovery. Knowledge comes to you. (All translations of quotations or of examples are mine).

following self-presentation: "Latest news and features on science issues that matter including earth, environment, and space. Get your science news from the most trusted source!" (www.scientificamerican.com). On the contrary, the Italian magazines show a more distant attitude, displayed, for example, by *Le Scienze*, which only underlines "Edizione italiana di *Scientific American*" (www.lescienze.it). Nonetheless, despite their slogans, these magazines share a common aim: to inform potential readers about the latest science news.

Table 1 presents the quantitative analysis of texts and illustrations, as well as the average length of texts and number of illustrations:

Table 1. The corpus.

	Scientific American	Science-Daily	Futura-Sciences	Sciences et avenir	Le Scienze	Focus	Total
Number of texts	29	143	81	49	21	5	328
Number of illustrations	29	143	173	70	26	8	449
Average number of tokens (per text)	1000	700	700	400	550	300	
Average number of illustrations (per text)	1	1	2,13	1,41	1,2	1,4	

4. Classification of the illustrations

The identification and analysis of the illustrations has been based on Lathene-Da Cunha (2013), who puts forward a methodology for classifying illustrations used in popularizing scientific discourse. Her idea follows the principle that an illustration has to be included in its support to be analysed. This approach has the advantage of inserting illustrations into a discourse genre and of allowing the comprehension of the purpose behind the illustration in the text. Her analysis of popularizing scientific magazine illustrations is based on a Peircean classification, thanks to which an illustration can be grasped through the sign and the reference that the sign contains. According to this semiotic path, a

sign is iconic if it is represented in terms of its similarity: hence, the sign is a hypoicon. It is possible to infer that the illustrations of the corpus are hypoicons, which may be divided into three categories: Peircean images, diagrams, and metaphors. This triple classification is actually, following Peirce (1978), a hierarchical one because images only show simple qualities or properties of the object and are a direct representation of it. Therefore, images allow a monadic relationship. The second category, the diagrams, is characterized by a dyadic relationship based on the analogy between the *representamen* and its object. Contrarily to the first category, this relationship has to be grasped by the reader; it is not direct. The third and most complex category, the metaphor, shows a triadic relationship, as it deals with a qualitative parallel or an implicit comparison between the *representamen* and something else (which is added to the second category). The person in charge of decoding the object has to create a first relationship and then a second one, which is superimposed on the first one but which has to be identified so as to have access to the content (Lathene-Da Cunha 2013).

Table 2 shows the frequency of the illustrations in the corpus, following their classification into Peircean images, diagrams and metaphors:

Table 2. Frequency of the illustrations in the corpus.

	PEIRCEAN IMAGES	PEIRCEAN DIAGRAMS	PEIRCEAN METAPHORS	TOTAL
Scientific American	27	/	2	29
ScienceDaily	133	9	1	143
Futura-Sciences	126	26	21	173
Sciences et avenir	53	13	4	70
Le Scienze	17	3	6	26
Focus	5	1	2	8
TOTAL	361	52	36	449

4.1. *Peircean images*

As previously mentioned, Peircean images are characterized by a monadic relationship between the object and its form, as this object is directly represented. Furthermore, this representation is similar to the object to which it refers and

relies on simple qualities or properties of it. Hence, it is possible to consider Peircean images as coming from reality because their representation does not need other references different from the object itself to be identified and interpreted. In the corpus of this study, as Table 2 shows, these illustrations are the most common in the six magazines.

As far as the objects of the images are concerned, it seems possible to infer that they are of a general type in our corpus. In fact, they often show the object or a detail of it, but in a very general way, not always linked to the caption or to the subject of the article as anticipated by the title. This is the case for example 1, taken from the French magazine *Futura-Sciences*, which shows a photo of a cow as a reference to mad cow disease. Although it is certain that this disease is represented by this type of animal, no details in the photo directly recall the disease. In fact, the animal in the picture does not seem to be ill, nor does the context around it suggest so, as the cow lies quietly on the grass. This picture only makes us understand that the animal is part of a farm, as the yellow labels typical of a breeding farm on its ears show.

1. 30.000 Britanniques porteurs de la vache folle? (*Futura-Sciences*)

La crise de la vache folle a fait beaucoup de bruit et a semé la panique en Europe au cours des années 1990. Selon une nouvelle étude, l'impact des prions va au-delà de ce que l'on croyait. En effet, il existerait un réservoir de prions caché à l'intérieur de la population et prêt à émerger. [3]

A similar attitude concerns example 2, taken from the Italian magazine *Le Scienze*: in the picture, two people, perhaps a couple, are sitting on the grass on a sunny day reading a book. The atmosphere is relaxing, as they are also smiling, but it is not possible to identify from the picture the type of book they are reading, nor if they are reading a book at all. On the contrary, the title of the article, but also the caption accompanying the picture deal with aspects that cannot be understood by the picture, as the type of reading linked to a particular type of literary works (in the caption).

2. Leggere di più per capire gli altri

La lettura di narrativa, secondo questo nuovo studio, ha un effetto positivo sulle competenze sociali, ma solo se si tratta di letteratura di alto valore artistico. [4]

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[3] [Are 30 000 British people vehicle for mad cow disease? The mad cow disease crisis made a lot of noise and caused panics in Europe in the 1990s. According to a new study, the impact of prions goes beyond what we previously thought. In fact, there exists a reservoir of hidden prions within the human population, ready to emerge]. To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/medecine-30000-britanniques-porteurs-vache-folle-49623/ (27/10/2015).

[4] [Read more to understand others The reading of fiction, according to a new study, has a positive

The attitude shown by these magazines also appears in the American ones: example 3, taken from *ScienceDaily*, concerns foetus health risks connected to smoking during pregnancy. The picture shows a woman who is smoking during pregnancy, but it does not give any information about the consequences this can provoke for the foetus, as the title and the caption do. This lack of conformity between the picture and the caption may depend on various factors, among which there is the impossibility of a perfect verbal representation of what is visually shown (Kress and van Leewen 2006), but also probably the choice of pictures recalling a general idea rather than explicating it. Indeed, a general sense of danger arises even because it is well-known that direct and indirect smoking is dangerous, especially during pregnancy. The title, the caption and the text of the article detail it, rather than the picture, which remains on a general level.

3. Smoking During Pregnancy May Increase Risk of Bipolar Disorder in Offspring (*ScienceDaily*)

Smoking during pregnancy is known to contribute to significant problems in utero and following birth, including low birth weight and attentional difficulties.

This is the first study to suggest an association between prenatal tobacco exposure and BD, a serious psychiatric illness marked by significant shifts in mood that alternate between periods of depression and mania. Symptoms typically become noticeable in the late teens or early adulthood. [5]

The observation of Peircean images shows that a tendency to generalize is common to all the six magazines concerned in this research. Nonetheless, another feature seems to emerge from these images: they are often the result of an acquired convention and of common-sense, probably because of the immediate relationship laypeople may identify between the image and a well-known situation highlighted by the media. This is the case in example 4, which deals with children affected by tuberculosis all around the world and with the need for financing research against this disease. As it mostly affects African children, the magazine has chosen the picture of a black, probably African, child who is 'simply' crying. Hence, there is no direct relationship, either between the child's attitude and disease of tuberculosis, or between him and the fact that tuberculosis affects 74,000 children per year, as the text title and the caption accompanying the picture put into evidence. That is the reason why it may be

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effect on social competence, but only as far as literature of high artistic value is concerned]. To view the illustration click on the link: http://www.lescienze.it/news/2013/10/04/news/leggere_romanzi_aiuta_competenze_sociali-1835057/ (27/10/2015).

[5] To view the illustration click on the link: http://www.sciencedaily.com/releases/2013/10/131001192155.htm (27/10/2015).

supposed that the journalist intended to catch public interest and to touch readers' sensitivity by showing a poor African child who is crying. S/he creates a dramatic effect and makes the readers feel pity for the child. This effect is also enhanced by the gaze of the child, which directly addresses the readers and creates an imaginary relationship with them (Kress and van Leewen 2006), namely in terms of affective participation.

4. La tuberculose emporte 74.000 enfants chaque année (*Futura-Sciences*)

Avec quelques efforts financiers, on pourrait sauver la vie de 74.000 enfants dans le monde chaque année en luttant contre la tuberculose, d'après l'OMS. [6]

Actually, Peircean image analysis demonstrates that all six magazines exhibit this last feature, but it is possible to infer that the magazine of example 4, *Futura-Sciences*, is the one which overtly shows a lack of impartiality, which should, on the contrary, be expected of the press. It is the only magazine in the corpus which contains some black and white images, where the lack of colours represents a precise intention of the magazine.

5. Parkinson: pas une, mais deux formes de la maladie (*Futura-Sciences*)

Les symptômes de la maladie de Parkinson ne s'expriment pas avec la même intensité chez tous les patients. Par exemple, dans la majorité des cas, des tremblements sont associés à cette maladie, mais ce n'est pas systématique. Une nouvelle étude montre qu'au niveau cellulaire, il existe deux mécanismes différents liés à la protéine alpha-synucléine, impliquée dans le développement de Parkinson. Ce qui expliquerait pourquoi les troubles sont variables d'une personne à l'autre. [7]

6. La dépression, un risque accru de développer Parkinson? (*Futura-Sciences*)

Selon les estimations du ministère de la Santé, près de 20 % des Français connaîtront au cours de leur vie un épisode dépressif. Bien qu'elle soit plus présente dans les pays

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[6] [Tuberculosis kills 74,000 children every year. Financial efforts could save 74,000 children worldwide per year in their fight against tuberculosis, according to the WHO]. To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/medecine-tuberculose-emporte-74000-enfants-chaque-annee-49608/ (27/10/2015).

[7] [Parkinson's disease: not one, but two forms of the disease. The symptoms of Parkinson's disease are not expressed with the same intensity in all patients. For example, in the majority of cases, tremors are associated with the disease, but this is not systematic. A new study shows that at the cellular level there exist two different mechanisms linked to alpha-synuclein protein, which is involved in the development of Parkinson's. This could explain why the disorder varies from one person to another.] To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/medecine-parkinson-pas-une-mais-deux-formes-maladie-49596/ (27/10/2015).

développés, la dépression peut toucher n'importe qui, à n'importe quel âge et ce, toutes classes sociales confondues.[8]

Examples 5 and 6 show very general images that represent two difficult situations, as the attitude of the young woman portrayed in (6) and the hands of an old person in (5), which symbolize the infirmities of old age, demonstrate. Furthermore, it seems that the lack of colour makes these situations seem worse. These images are used to refer to Parkinson's disease and nothing apart from the captions, the titles and the articles, recalls it directly. Through the corpus analysis, it has been possible to find the same use of black and white images in this journal every time Alzheimer's disease is discussed. Thus, it could imply the intention of *Futura-Sciences* to focus on particular and, unfortunately, more and more common diseases in a dramatic fashion. The effect these images provoke in the readers should be of interest and probably also of fear and alarm. Their presentation in a different way when compared with images in the five other magazines reveals somehow the journalist's intentions: "[i]l s'agit donc de faits qui [...] donnent lieu à une vaste production discursive dans les médias [...], parce qu'ils sont de nature à inquiéter, donc à attirer lecteurs et spectateurs [...]"[9] (Moirand 2005, 82). Therefore, it seems that this feature of *Futura-Sciences* openly violates the respect of neutrality, which is one of the tenets included in the communication contract between the different media and their addressees (Charaudeau 1997) that each press organism should implicitly sign.

4.2. *Peircean diagrams*

Peircean diagrams are a category less represented in the corpus than Peircean images, but more than Peircean metaphors. It is interesting to note that one of the six magazines analysed, *Scientific American*, to which it is also possible to add *Focus* (in only one case), does not contain any diagrams – which are present, albeit not very frequently – in the other magazines. Their low presence in this corpus may depend on the type of corpus collected – that is, magazines of science popularization. Peircean diagrams imply a similarity between

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[8] [Is depression related to a higher risk of developing Parkinson's disease? According to the projections of the Ministry of Health, almost 20% of French people will experience an episode of depression during their lives. Even though depression is more frequent in developed countries, it can affect anyone, at any age, and from any social class]. To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/medecine-depression-risque-accru-developper-parkinson-49458/ (27/10/2015).

[9] [It deals with events that provoke a vast discourse production in the media, because they present a troubling nature aimed at attracting readers and audience].

the *representamen* and the object, which is based on an analogy of their parts. In addition, diagrams are often composed of many terms which stand on the same level and display a dyadic relationship. Hence, the object representation has to be mediated and its content becomes accessible only after the identification of the link between the terms implied. That is the reason why it is more difficult for the reader to have access to diagrams rather than to simple images. This feature of diagrams also explains their frequency in scientific and technical publications of different domains, such as medicine, differently from what should happen in popular scientific magazines which are aimed at immediate understanding of the phenomena cited in the articles.

In the present work, the term 'diagrams' refers to different types of charts, and more in generally, to a tool which contains scientific data that must be communicated to the readers. A Peircean diagram may then take the classical form of a graph presenting the evolution of a phenomenon, as in example 7, which concerns growth in consumption of medicines in Italy:

7. Consumiamo ancora troppi farmaci (*Focus)*

Distribuzione annuale del numero e del tasso di segnalazione per milione di abitanti 2001≠2012. [10]

but it can also concern a schematic illustration of the functioning of a system or of a mechanism, as in example 8:

8. Imaging Breast Cancer With Light (*ScienceDaily*)

A schematic illustration of the imaging system and the ultrasound detector. [11]

or a comparison between two situations to show their differences. This is the case for example 9, where a new innovative technique is compared to the traditional one, shown in the first of the two illustrations:

9. La fluorescence proche infrarouge dévoile davantage les cellules
   (*Futura-Sciences*)

Dans le domaine du visible (image de gauche), les éléments de la cellule possèdent une fluorescence naturelle qui rend difficile la distinction avec le signal de fluores-

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[10] [We are still consuming too many medicines. Annual distribution of signaling number and level per million inhabitants 2001≠2012]. To view the illustration click on the link: http://www.focus.it/scienza/salute/consumiamo-ancora-troppi-farmaci-857681 (27/10/2015).

[11] To view the illustration click on the link: http://www.sciencedaily.com/releases/2013/10/131023125621.htm (27/10/2015).

cence émis par un marqueur spécifique. L'autofluorescence étant moindre, voire inexistante dans le domaine du proche infrarouge, cela permet de distinguer et de localiser de façon non ambiguë le signal de fluorescence émis par un nouveau marqueur à base de lanthanides (image de droite). [12]

These examples, which show some typologies of Peircean diagrams, allow an understanding of the important role played by this category in the corpus and, more generally, in the popularization of scientific discourse of medicine. Nonetheless, as their comprehension is not always immediate for laypeople who are interested in science but are not experts, captions often intervene to facilitate the reader's immediate understanding with explanations that guide him/her to a correct interpretation of the phenomena displayed. On the other hand, the journalist-mediator, apart from helping the readers visualize the scientific phenomenon, uses diagrams as a source of authoritativeness (Casalmiglia and Van Dijk 2004). In fact, diagrams allow the author to link popularized scientific content to its scientific source. In other words, it is a way for the journalist to legitimise his/her own discourse. To confirm it, it is sufficient to think that even captions which generally accompany each diagram do not explain and make it completely explicit. Diagrams present data that are almost always in part left unexplained in the caption, as well as in the body of the text. As already pointed out, this depends not only on the impossibility of representing verbally what is visually shown (Kress and van Leewen 2006) but also on the diagram and on the author's purpose. Indeed, in popularizing texts the journalist uses and shows scientific data to legitimate his/her own discourse, but s/he has to adapt them to his/her addressees, who are less interested in technical data than in a general understanding of the diagram.

4.3. *Peircean metaphors*

Finally, the third category of Peircean images is the least represented in the corpus: it only concerns 36 cases, more than half in the French magazine *Futura-Sciences*. As already underlined, this type of illustration requires a triple passage on the part of the reader, who has to find not only the analogy between

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[12] [Near-infrared fluorescence allows to unveil cells better. In the visible domain (on the left), cell elements have a natural fluorescence which makes it difficult to distinguish the fluorescence signal emitted by a specific marker. As autofluorescence is almost absent in the near-infrared domain, this makes it possible to distinguish and to locate in an unambiguous way a fluorescence signal emitted by a new marker based on lanthanides (on the right)]. To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/biologie-fluorescence-proche-infrarouge-devoile-davantage-cellules-49547/ (27/10/2015).

the *representamen* and the object, but also a similarity based on an additional parallel. Furthermore, this triadic relationship is composed of three overlapping levels which must be simultaneously dissociated in order to understand the object. These features show that this category is the most difficult to create for the journalist, but it is also the most immediate in terms of comprehension for the readers, who can easily have access to its meaning. In fact, a metaphor is generally the result of a convention, based on the way a phenomenon is displayed by the media: "[c]'est ainsi au récepteur de construire la référence avec les unités de contenu du texte […] appliqué[e]s à l'image pour faire saisir la relation de ressemblance […] et […] avec les éléments de l'image appliqués au texte pour faire saisir la proportionnalité entre les deux objets."[13] (Lathene-Da Cunha 2013, 140).

All these features appear in examples of the corpus, where journalists tend to choose elements familiar to the readers and brilliant colours to show a scientific concept which becomes simplified and accessible even for non-experts. That is the case for the human brain presented as a complex engine when dealing with the potentialities of human memory, in example 10:

10. Dossier: la connaissance de la mémoire au fil des âges (*Futura-Sciences*)[14]

Other metaphors, even though less used in the other magazines, often concern a picture modified in some of its elements so as to boost readers' immediate understanding, often in a funny way. In example 11, taken from the Italian magazine *Le Scienze*, for instance, the relationship between Facebook and bad moods is represented by a man sitting in front of his computer who has, instead of his head and face, a yellow sad balloon, and is underlined by the title of the article:

11. Quella sottile relazione tra Facebook e il malumore[15]

As shown by these examples, the scientific concept is mediated in a simplified way by metaphors, which are not always accompanied by captions, as in the last two examples. This could depend on the magazine's policy, but also,

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[13] [Hence, the receiver has to construct the reference with the content of the text […] applied to an image to seize the resemblance relation […] and […] with the elements of the image applied to the text to seize the proportionality between the two objects].

[14] [Dossier: knowledge of memory during life]. To view the illustration click on the link: http://www.futura-sciences.com/magazines/sante/infos/actu/d/medecine-dossier-connaissance-memoire-fil-ages-49558/ (27/10/2015).

[15] [The slight relationship between Facebook and bad moods]. To view the illustration click on the link: http://www.lescienze.it/news/2013/10/05/news/facebook_socializzazione_tristezza-1835546/ (27/10/2015).

perhaps, on the immediacy of the metaphor, which does not need any explanation to be understood.

Hence, on the one hand, metaphor is surely the most popularizing category. Nevertheless, on the other hand, it is also the least scientific one in terms of technical data and of scientific processes displayed. The journalist who uses it acts as a real mediator but s/he also distances him/herself from the scientific source. It is perhaps the reason why Peircean metaphors, which also require a supplementary effort from the journalist, are the least used category in the magazines of the corpus.

5. Contrastive and concluding remarks

In general, the analysis of the corpus has shown that the French and the Italian magazines tend to use more illustrations than the American ones per article. When considering their categorization, all the magazines present a huge number of Peircean images, a more restricted use of Peircean diagrams, and a lesser use of Peircean metaphors. The analysis of Peircean images has underlined that, except for the French magazine *Futura-Sciences*, their use is 'standardized', as these illustrations are typical of each text and represent the more 'neutral' category used by the journalists-mediators, who are generally the text authors. The adjective 'neutral' acquires a double sense in this context. On the one hand, it refers to neutrality in the sense of 'unstressed', because the authors of our texts use Peircean images as a sort of announcement of what the article is about, so in a simple thematic function as accessorial elements in the text and as general images adaptable to different contexts. On the other hand, 'neutral' acquires the meaning of 'objective', as the choice of these images, although personal, does not communicate any effect different from common sense. This characteristic is in contrast to the lack of neutrality displayed by *Futura-Sciences*. This magazine chooses to use Peircean images full of meaning, simply by exploiting black and white images. This strategy surely serves to direct readers' attention to a dramatic topic, such as Alzheimer's and Parkinson's diseases.

Peircean diagrams represent an intermediate category in terms of frequency, probably because they generally serve to communicate technical information in the form of graphs and tables, which are not always included in the articles of a popular scientific magazine. From another point of view, through these illustrations authors may legitimate their own popularizing discourse and link it to its scientific source (even though our corpus diagrams are rarely scientific in a strict sense, as their source can also be *Wikipedia*). That is the reason why Peircean diagrams can be accessorial and have a thematic function, but they can

also show a rhematic function if they represent an additive source of important details about an experimental process (Lathene-Da Cunha 2013).

The last category of illustrations, Peircean metaphors, is the most immediate one to understand for the readers, as it is based on a convention, but it is the most complicated to create. In fact, the journalist-mediator must make an effort due to the triple passage subsumed and to the research of elements which may be familiar to readers. In addition, the choice of a metaphor instead of an image or a diagram is a way for journalists to distance themselves from the science and, simultaneously, to get closer to the target readers. Finally, according to the features related to metaphors, their function is always thematic and accessorial for the article content, but necessary for the readers because a reconceptualization of complex scientific processes in more accessible terms is displayed (Garzone 2006).

To conclude, Peircean categories of the illustrations of six popularizing scientific magazines in their medicine sections have shown a general inclination to use these illustrations in a thematic function rather than in a rhematic one, with the exception of some diagrams which basically contain new scientific information. A general tendency emerges: a lack of neutrality in the French magazine *Futura-Sciences*, which, however, does not mean that the other magazines are always objective. In fact, the use of generic – perhaps too generic – images can be a way of distancing them from the author's opinion, but also a way for the author to fall, perhaps unconsciously, into dangerous stereotypes, as the example of the photo of the black child to talk about tuberculosis demonstrates. More generally, our research has shown that, as Kress and van Leewen (2006, 19) argue, "[b]oth language and visual communication express meanings belonging to and structured by cultures in [a given] society [but] the semiotic processes […] are broadly similar".

Further research on illustrations used in popular scientific magazines in the three languages analysed in this study may be interesting to show whether the same tendencies are to be found. In addition, it could be interesting to put forward a further and more detailed distinction within the three Peircean categories, for example by identifying additional subcategories according to the sources where they come from.

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ABSTRACT

This article deals with illustrations in popularizing medical discourse. This visual tool can be considered as a strategy of paraphrasing, since popularizing journalists simplify and make information more explicit by using other semiotic information related to the main scientific content. A comparable corpus composed of the online versions of two American, two French and two Italian magazines of science popularization has been analysed. The role of illustrations, as well as their usefulness in terms of comprehension of the text, has been highlighted through a socio-terminological approach (Gaudin 2003). As far as a typological distinction of the illustrations is concerned, a Peircean classification has been adopted (Fisette 2009; Lathene-Da Cunha 2013). A number of observations emerge from the comparison between the magazines, per type and per language: the article shows that, while some illustrations contribute to a better intelligibility of the article's content, others influence readers' sensitivity.