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The Explicit/Implicit Distinction in Multimodal Argumentation: Comparing the Argumentative Use of Nano-Images in Scientific Journals and Science Magazines

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The distinction between explicatures and implicatures as well as their varying degrees of strength acknowledged within Relevance Theory can help to capture the complex meaning-making processes underlying the interpretation of multimodal texts as instances of argumentation. These pragmatic insights will be used to compare the ways in which arguments about the revolutionary character and societal impact of nanotechnology are constructed by computer-generated images of the nanoscale on the covers of scientific journals and science magazines.

KEYWORDS: front covers, explicatures, implicatures, multimodal argumentation, nano-images, popular science magazines, science communication, scientific journals; visual flag

1. INTRODUCTION

As Bateman (2014) explains, the apparent effortlessness of perceiving visuals simply by having our eyes open and looking at them is revealed to be an illusion when we are confronted with visual representations with which we are not familiar: "Then just seeing is replaced by a more conscious attempt to work out what is going on" (p. 8). Computer-generated images that present structures or processes at the scale of a billionth of a meter, which are invisible without the use of special microscopes and visualization software, are one such type of image. These so-called nano-images, produced by electron microscopes or

Oswald, S. & Maillat, D. (Eds.) (2018). *Argumentation and Inference: Proceedings of the 2nd European Conference on Argumentation, Fribourg 2017* (Vol. II, 821-842). London: College Publications.

created by artists, are used on the covers of scientific journals and science magazines to construct arguments about the revolutionary character and societal impact of nanotechnology. The study of the front cover as a multimodal genre that employs images and text to promote the sales or readership of the magazine requires the combination of insights from multimodal discourse analysis and argumentation theory (Jewitt, 2014; Norris & Maier, 2016; Tseronis & Forceville, 2017). When studying multimodal argumentation, the analyst needs to pay attention not only to the content and form (verbal or visual) but also to the context, in order to reconstruct the standpoint and the arguments brought forward in support of it.

For a better understanding of what it is about image-text combinations that guides the receivers of multimodal texts along particular lines of interpretation than others, the analyst also needs to have recourse to the inference process that receivers undergo. Relevance Theory's (Sperber & Wilson, 1995) focus on how both the explicit and the implicit side of communication give rise to inference can allow for a comprehensive account also of the ways in which the information derived from the visual mode contributes to the meaning-making process, and thereby to the construction of a multimodal argument. Choices regarding the visual content and style can thus be shown to guide the viewer to infer implicatures or explicatures constrained by the viewer's encyclopaedic knowledge and the broader situational context. Nanoscientists and the general public, confronted with nano-images on the covers of scientific journals and science magazines, respectively, will interpret these differently given their respective background knowledge and expectations.

The goal of the paper is twofold: a) to explore the potential of concepts proposed by Relevance Theory for the argumentative analysis of multimodal discourse; b) to apply these insights to the argumentative analysis of a concrete multimodal genre, namely the front covers of science magazines and scientific journals, where nano-images are used. With reference to degrees of explicitness and implicitness it will be shown how the arguments reconstructed from the covers with nano-images in scientific journals and science magazines differ.

2. RELEVANCE THEORETICAL INSIGHTS FOR THE ANALYSIS OF MULTIMODAL ARGUMENTATION

2.1 Multimodal argumentation

In the last twenty years, argumentation scholars have shown interest in the role of images and other semiotic modes in argumentative communication (spoken or written) (Birdsell & Groarke, 1996; Blair, 2004; Groarke, 2015; Groarke et al., 2016; Kjeldsen, 2015; Tseronis, 2017; Tseronis & Forceville, 2017; van den Hoven, 2012). This visual turn in the field of argumentation studies has been partly facilitated by the acknowledgment that argumentation as a communicative activity is multimodal, in the sense that, more often than not, standpoints and arguments in support of them are communicated by a combination of semiotic modes, as is the case with communication in general (Kress, 2010). Multimodal argumentation can thus be broadly described as a communicative activity, in which more than one mode, other than the verbal (be it spoken or written), play a role in the procedure of testing the acceptability of a standpoint. Semiotic modes combined in multimodal discourses that seek to convince an audience include: written language, spoken language, static images, moving images, music, non-verbal sound, gestures, gaze, and posture.

The acknowledgement of the inherent multimodality of communicative practices has opened a cross-disciplinary dialogue between argumentation scholars and researchers in areas such as visual communication, semiotics, multimodal analysis, and media studies, among others, for a comprehensive study of situated and mediated argumentative practices (Tseronis & Forceville, 2017). The work carried out in the field of multimodal analysis in particular (Bateman, 2014; Jewitt, 2014; Jewitt et al., 2016; Sanz, 2015) has been of great relevance to this direction. In this area of discourse analysis, concepts have been developed for the study of the affordances of various semiotic resources, and, more importantly, of the ways in which meaning is conveyed by the interaction of the verbal and the visual (or other non-verbal) modes. These concepts can be fruitfully combined with analytical categories from argumentation and rhetoric in order to account for the argumentative interpretation of multimodal texts.

In line with the multimodal analysis of communication, argumentation theorists need to pay attention to both the content and the form of each mode. In addition, one needs to study not only each mode separately but also the way modes combine, while paying equal attention to both the (verbal / visual) content and the (verbal / visual)

form. Finally, attention also needs to be paid to the context (argumentative situation, audience, genre) in which a multimodal text is produced and interpreted. Birdsell and Groarke (1996, p. 5) have stressed early on the important role of context when analysing and evaluating visual arguments by identifying three layers that need to be considered: the immediate visual context, the immediate verbal context, and the visual culture. In order to better account for the ways in which context affects the interpretation process, I have recourse in this paper to Relevance Theory, which is a cognitive pragmatic theory of communication that takes a dynamic approach to the way context guides and constrains the inference process on both the explicit and implicit side of communication (see also Tseronis, 2018).

2.2 The explicit-implicit distinction

There is a tendency in the literature on visual and multimodal argumentation to equate rather hastily the distinction between what is explicit and what implicit, respectively with the verbal mode and the visual mode. This view follows a more or less standard approach in pragmatics which equates explicit and implicit meaning with encoded and inferred meaning, respectively. In this view, an illocutionary act is performed explicitly when a performative is used that names the act performed, while it is performed implicitly when no such performative is used. Compare "*I promise* I'll be there" with "I'll be there". Within a speech act theory perspective, there is a further distinction proposed between direct and indirect speech acts, the latter having a grammatical form that is more closely associated with one type of act than the one for which it is used in a given context. Consider, for instance, the textbook example of the interrogative sentence "Can you pass the salt?" used to *request* the addressee to pass the salt rather than to *enquire* about his/her ability to do so.

Even visual semioticians consider that images do not constitute an explicit form of communication. Nöth (2011, p. 310), for one, writes:

> A picture cannot express explicitly whether it is used to ask a question, to give an order, to threaten, to make a promise, or to congratulate. Hence, a theory of pictorial acts can only be a theory of indirect pictorial acts. If a picture addresses its readers with the purpose of asking a question or warning against a danger, the pictorial question or warning can only be an indirect one.

With this comment, however, Nöth overlooks the fact that an image – like a verbal text – is never communicated in void, and that there are visual and other formal cues as well as knowledge of the situation and genre that allow one to distinguish when it is used to warn one from when it is used simply to inform or to create a humorous effect.

Contrary to this view, Novitz (1977, p. 92) stresses the fact that to be able to specify the proposition an image may convey, one needs to know how that image is used:

> My argument will be that, for the most part, it is in virtue of certain contextual features that we can reasonably say of a picture that it is used to indicate a flower and to attribute a certain structure to it. The context, one might say, provides certain clues as to how the picture is being employed: what illocutionary act it is being used to perform and what proposition it is made to express.

The equation of explicitness with the verbal mode and of implicitness with the visual mode is problematic in several respects:

- It neglects the fact that there is nevertheless something that is depicted in an image and thereby that some (visual) content is provided.
- It backgrounds the fact that there is inferencing going on also when an addressee seeks to understand a message conveyed entirely in the verbal mode.
- It reduces the explanatory and analytic potential of the distinction between implicit and explicit aspects of communication since almost all naturally occurring communication (verbal or non-verbal) ends up being analysed as indirect and implicit.

The cognitive and pragmatic approach to communication that Relevance Theory assumes (Sperber & Wilson, 1995; Wilson & Sperber, 2012; Wilson, 2017) acknowledges the role that context and inference processes play for the recovery of both the explicit and the implicit content of messages. As Wilson (2017, p. 92) puts it:

> For relevance theorists, 'explicit' is both a classificatory and a comparative concept: any communicated proposition with a linguistically encoded conceptual constituent is explicit to some degree, and the greater the proportion of decoding to inference, the more explicit it will be. On this approach, any

> utterance can be made more explicit, and there is no such thing as 'full explicitness'.

According to Relevance Theory, utterance comprehension is an inferential process based on the assumptions derived from the explicit content of a message and further contextual information, guided by the principle of relevance. As Wilson (2017, p. 90) explains:

> interpreting an utterance is like solving a complex simultaneous equation, and the interpretation process is crucially seen as carried out in parallel rather than in sequence. It is not a matter of first identifying the explicit content, then supplying contextual assumptions and then deriving contextual implications (and other cognitive effects), but of mutually adjusting tentative hypotheses about explicit content, context, and cognitive effects, with each other and with the presumption of relevance, and stopping at the first overall interpretation that makes the utterance relevant in the expected way.

While originally the focus of relevance theorists has been almost exclusively on verbal communication, the theory's broad definition of ostensive communication makes it possible to apply relevance theoretical distinctions to other modes and media of human communication (see Yus, 1998, 2011; Ifantidou & Tzanne, 2006; Wharton, 2009; Desilla, 2013; Forceville, 2014; Forceville & Clark, 2014). The relevance theoretic comprehension heuristic described in the previous quote can thus also prove useful for arriving at the premises and the conclusion of an argument that is wholly or partially communicated by means of visual elements. The meaning of images is not simply encoded in what the image depicts or in the visual properties it has. It is the constant interaction with the viewer's cognitive environment at a given time and place that determines what a visual (verbal or multimodal) stimulus means. The information available to the viewer may vary depending on his/her own encyclopaedic knowledge but also on the time and place. The way the image-maker presents the message gives clues to the audience and guides them in order to reinforce or adjust their assumptions.

One can thus distinguish what an image depicts (the proposition or propositions communicated, as it were) from what one means to communicate by that image (its interpretation). In the first case, the viewer arrives at a conclusion about what the image depicts, based on inferences drawn from what is directly visually available (in terms of

form and style, shapes, lines, colour etc.), and with reference to encyclopaedic and other background knowledge. In the second case, the viewer arrives at a conclusion about what the producer of the image means to communicate, based on inferences that make use of the conclusion about what the image depicts and broader encyclopaedic knowledge (paying attention to the situational context, who made it, addressing whom, in which medium/genre, at what given moment, etc.). Following the distinction between explicatures and implicatures proposed by Relevance Theory, I would then suggest that the former communicated assumptions be considered as 'explicatures' and the latter as 'implicatures'. The explicatures of an image would thus be the assumptions recovered from the visual content of an image (what is depicted) enriched from background knowledge and from any verbal or other visual co-text or context present. The implicatures of an image would be the assumptions recovered entirely on the basis of inferential processes making use of background knowledge and any co-textual or contextual clues (verbal, visual or other).

At this point, I need to acknowledge that the above proposal does not strictly follow from Relevance Theory's original identification of explicitness with the linguistically encoded meaning (or logical form) of an utterance (Sperber & Wilson, 1995, p. 182). In the case of visual and multimodal communication, it is in fact debated whether drawings, photos and paintings, for example, can be said to consist of minimal units of meaning encoded in such a way that guarantees their interpretation by all those who share that code. Forceville and Clark (2014) have taken up the challenge to explore the possibility that explicatures or 'explicature-like' assumptions are communicated by visuals, acknowledging that there are, after all, varying degrees of codedness in visual and non-verbal signs. While the theoretical and terminological issue is far from settled, suffice it to say that for the purposes of this paper the distinction between explicit and implicit content along the lines proposed by Relevance Theory (see Carston, 2009) is a pertinent one for the analysis of multimodal argumentation, in particular, for one more reason next to those listed above. By recovering the assumptions based both on the explicit and on the implicit side of what is communicated it also becomes possible to determine the propositions to which the image-maker can be committed, whether recovered from what is explicitly communicated or from what can be reasonably implicated, and thereby to assign varying degrees of strength to these commitments (see Tseronis, 2018). In this way, a systematic and theoretically-driven answer can be provided to the questions raised by critics of visual and multimodal argumentation,

regarding what is communicated by images and multimodal texts, and how can the analyst attribute commitments to their makers.

3. NANO-IMAGES ON THE FRONT COVER

3.1 Front cover as a multimodal argumentative genre

The front cover is generally considered as the show window of a magazine that attracts the readers' attention and informs them about the stories featured in the inside pages. Held (2005, p. 173) defines front covers as a multimodal media genre "which announces, indicates and appraises subsequent texts inside the magazine". From an argumentation studies perspective, front covers can be described as an argumentative activity type that belongs to the domain of commercial communication whose institutional point is to promote products and services (on argumentative activity types, see van Eemeren, 2010).

In previous studies (Tseronis, 2015, 2017), I have distinguished two interrelated levels of argumentation put forward by a front cover: the primary level concerning the argumentation *of* the cover, where the standpoint advanced is the one inciting the public to buy the specific issue of the magazine; and the secondary level concerning the argumentation *in* the cover, which pertains to the standpoint that the editors of the magazine assume over the specific cover story. These two levels are presented together in the following structure:

1. Buy the specific issue of the magazine
1.1a The main story that the magazine covers is on issue X
1.1a' Issue X is a newsworthy / important / relevant topic for the reader
1.1b The magazine takes position P on the main story
    1.1b.1 …. [The argumentation *in* the front cover]
1.1b' The position of the magazine reflects its profile (investigative journalism, etc.) / resonates with the reader's position on current issues

While the above structure can be considered as typical of the front cover as an argumentative genre, in general, more specific argumentation structures can be described when considering the slightly different argumentative goals served by the popular science magazine cover compared to the scientific journal cover. In the former, the choices made regarding the content of the image and its visual style can be related to the communicative goal of increasing the sales of the particular magazine. In the latter, however, these choices can be primarily related to the claim regarding the ground-breaking and innovative research reported in the particular journal.

Compared to the front covers of news magazines where image and text can be reconstructed as conveying a certain editorial viewpoint on the main story (the argumentation *in* the cover), the front covers of scientific journals and popular science magazines do not appear to have this secondary level of argumentation. Image and text in these cases combine in order to attract the potential reader's attention to the specific issue and to the main story or article covered. The covers of scientific journals and popular science magazines can thus be understood as functioning as 'visual flags'.[1]

Considering the fact that popular science magazines and scientific journals address two different kinds of audience with the distinct (but related) purposes to inform the general public about potentially interesting applications of science and technology, on the one hand, and to inform the scientific community about current research, on the other, two argumentation structures can be distinguished:

> Argumentation of the science magazine cover:
> 1. Buy this issue of the magazine
> 1.1 The main story that the magazine covers is on issue X (e.g. nanotechnology and nanoscience)
> 1.1' Issue X is a **newsworthy / important / relevant** topic for the reader

> Argumentation of the scientific journal cover:
> 1. Read this issue of the journal[2]
> 1.1a The scientific research published in this journal (e.g. concerning a specific area within the field of nanotechnology and nanoscience) is **ground-breaking**
> 1.1b The results of the research (e.g. concerning a specific area within nanotechnology and nanoscience) published in this journal have **direct/positive applications** in society
> 1.1a-b' The research featured on the cover is a good example of both / either.

[1] The term was coined by Groarke (2002; see also Groarke & Tindale, 2013, pp. 143-158) to describe the function of visuals (potentially combined with text) to attract the viewer's attention to the argument.

[2] Assuming that scientific journals address scientists in academic and research institutions that already have online access to these journals, the inciting standpoint in this case is not so much about 'buying' the specific issue as it is about 'reading' the issue or a specific article within it.

In both types of publication, the choice of the image, layout and wording on the cover is of primary importance. It does not only reflect the ethos, as it were, of the specific publishing house, it also seeks to raise the reader's interest in the specific article or study (see Grampp, 2015). The image and the text together with information derived from the context help the reader to recover assumptions in order to assess the relevance (in the technical sense) of the premises regarding newsworthiness / importance or the ground-breaking character and the plausibility of the research (that is to help him/her arrive at the premise 'the story is newsworthy / important' or the premise 'the research is ground-breaking' or 'the research has societal applications', respectively, in the two argumentation structures presented above).

As explained in section 2.2, the recovery of the intended assumptions will depend not only on the extent to which the producer of the message has made these (more) manifest but also on the extent to which the reader is in a position to retrieve these from the cognitive environment. The strength of the explicatures will thus depend on how strong the manifestness of the intention of the image-maker is to communicate something (the more this is encoded, the more explicit) (see Clark, 2013, p. 212). The strength of the implicatures will depend on how much pragmatic inference is required in their recovery (the more infernceing, the weaker the implicatures will be). How familiar one is with related images, the scientific area, and what associations one can make will all play a role in recovering the explicatures and implicatures, and eventually in arriving at the interpretation about newsworthiness or the ground-breaking character of the research. In the following section, I focus on images of the nanoscale appearing on the covers of specialized scientific journals and popular science magazines.[3]

3.2 Nano-images

One area of research where visualization and computer-generated images have played an essential role early on, both for the scientific community and the general public, is nanotechnology. In this field of research, chemistry, physics, biology and engineering converge in order

[3] I am not interested here in explaining how these images are interpreted and processed in general, but only in their argumentative interpretation when they are used in a specific genre. That is why I am focusing on their use in the front cover, assuming that front covers have a certain argumentative goal as I have explained in this section.

to study matter at the scale of a billionth of a meter (Roco & Bainbridge, 2002). Strictly speaking, images of nanostructures (see Figure 1) cannot be said to represent or depict, because they visualize something which, despite its physical substance, remains invisible without the use of digital imaging tools and related software (Ruivenkamp & Rip, 2014).[4]

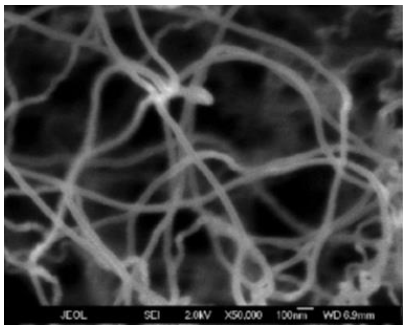

Figure 1 – Z.F. Ren, carbon nanotubes shown under electron microscope, 1998. (© Nano-Lab, Inc.)[5]

Despite their virtuality, or precisely because of it, these nano-images are used by various stakeholders (scientists, (non-)government agencies, science journalists, and science activists) in multimodal texts which communicate various views about nanotechnology. Next to their imaging function of visualizing matter at the nanolevel, nano-images such as the so-called Nanolouse (see Figure 2) exercise great evocative power by inviting the viewer not only to imagine how nanostructures actually look like but also to picture the future nanoworld promised by nanoscientists. It thus comes as no surprise that colour-enhanced, 3D computer generated images of the nanolevel feature on the front covers of popular science magazines and online image-galleries. Interestingly, similar images also appear on the covers of scientific journals specializing on nanotechnology (see Ottino, 2003).

[4] The scanning tunnelling and electron microscopes operate in a way that is akin more to 'touching' than actually 'seeing', and the data generated must be converted by computer software into a visual representation (Wickson, 2010).

[5] Available at: http://www.nano-lab.com/nanotube-image.html (last accessed 6 September 2017).

Figure 2 – The so-called Nanolouse; digital illustrator Coneyl Jay's impression of a nanobot in the blood taking test samples. Winner of the 2002 Visions of Science Award.[6]

The images on the cover may be of the grey-scale type representing the nanolevel visualized by a scanning tunnelling microscope (such as in Figure 1) or they may be an artist's rendition of that level (such as in Figure 2). For a typology of nano-images found in image galleries, see de Ridder-Vignone and Lynch (2012). For a typology of images appearing on scientific journals, see Grampp (2015). Choices in colouring, perspective, and overall composition can sometimes be related to a specific coding scheme that specialists are in a position to identify (for example, the use of 3D billiard-ball-like shape for atoms or the colouring of carbon atoms in light-grey; but see Ruivenkamp & Rip (2010) for more discussion about the fact that such coding is not really fixed in the case of nanotechnology). More often than not, the colouring and 3D perspective used on the front covers tend to create associations with more familiar scenes borrowed from the macro-world (landscapes, elements of the natural world, machines, etc.) or which appeal to both the general and the specialized audience's cultural knowledge. Besides the meaning conveyed by the visual content and the visual style of the particular nano-image, an extra layer of meaning is provided by the short text about the cover that accompanies

[6] Visit http://www.coneyljay.com/nanotechnology (last accessed 6 September 2017).

it, as well as by the way the image is contextualised (how it relates to the featured article of the specific issue and to other images in it).

4. POPULAR SCIENCE MAGAZINES VS SCIENTIFIC JOURNALS

As suggested in section 3.1, the front cover functions as a 'visual flag' that attracts the reader's attention to the story or research study featured inside. As such it serves the broader argumentative goal of the magazine or the journal, which is to increase the sales and citations, respectively. Furthermore, in section 3.2 it was observed that computer-generated, aesthetically pleasing and artistically rendered images of the nanoscale appear not only on the front covers of popular science magazines, addressing a general audience, but also on the covers of specialised scientific journals, addressing scientists working in the field of nanoscience or related fields. In this section, I compare the nano-images appearing on the front covers of science magazines with those appearing in scientific journals, and discuss the way these images are contextualized. The aim is to illustrate how the inference process described by Relevance Theory can help to account for the ways in which the readers of the front cover arrive at the premise regarding the value / contribution of the story/research article (see structure above), constrained by their own cognitive environment and the way the images on the cover are designed.

A quick look at the online archives of popular science magazines such as *Scientific American* and *Popular Science*, on the one hand, and scientific journals specializing on Nanotechnology and Nanoscience (such as *Nano Letters* and *Nanoscale*, or *Nature Nanotechnology*), on the other, makes it clear that in both types of publications computer-generated, and aesthetically pleasing images are used which, however, are not immediately familiar and self-explainable to a general or even specialized audience. Even the text that appears on the cover in the form of a caption or title does not always help to identify what it is one is looking at.

The biggest difference between the nano-images appearing on the covers of popular science magazines and those on the covers of scientific journals is that the latter are almost always produced by graphic designers and illustrators who collaborate closely with the authors of the specific research article that appears inside the journal. Most of the time, a text about the cover and its relation to the research reported inside the specific issue appears on the contents page to help identify the main topic, and even explain how the image was produced. This is the case, for example, with all the covers of *Nano Letters* (one of

the first scientific journals to specialize on nanoscience and nanotechnology since 2001), and the covers of *Nature Nanotechnology* from 2008 onwards (the caption provided in the issues from 2006 until end of 2007 was barely informative). Other scientific journals, however, such as *Nanoscale*, provide no information about the image of the cover, except for referring to the article from which the artistic image was inspired.

Nano-images appearing on popular science magazines featuring a topic on nanoscience and nanotechnology tend to be simple, depicting a rather concrete item (the tip of the scanning tunnelling microscope, a cancer cell attacked, or nanoparticles). On the other hand nano-images on the covers of scientific journals are more complex, depicting a certain process in more detail. Grampp (2015) suggests that cover images in popular magazines are more allegoric and symbolic, while those of scientific journals are more indexical and iconic. Nevertheless, as he notes:

> the choice of indexical or iconic presentation forms has a certain price. It remains uncertain what exactly is being displayed or what is actually supposed to be described. Even though we are looking at concrete items of the external reality we do not exactly know what these concrete things are or what is being described by them (pp. 167-168).

When comparing the way the nano-image on the front cover is contextualised, that is the way it relates to the images and the text of the article appearing inside the magazine or journal, one also notes a number of differences. In the case of popular science magazines, the image is simply repeated in smaller or bigger size, cropped differently, while in the case of scientific journals one finds images and schematics inside the article which are even more concrete and complex, and have only a vague resemblance to the image of the cover.

To illustrate the above observations and to show how the readers' cognitive environment and the images' visual style could constrain the recovery of explicit and implicit content, I compare two covers of popular science magazines with two covers of scientific journals devoted on related topics. First, I compare the cover of the science magazine *Scientific American* and the cover of the scientific journal *Nature Nanotechnology* (see Figure 3 and Figure 4, below), which both depict the tip of the atomic force microscope, the instrument that together with the accompanying visualization software makes it possible to 'see' structures at the nanolevel (see also note 4, above).

Figure 3 – Cover of September 2001. Photograph by Felice Frankel, with technical help from J. Christopher Love.

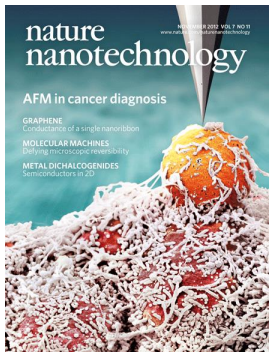

Figure 4 – Cover of November 2012. Image: Eva Bieler, Marija Plodinec, Roderick Lim. Artwork: Martin Oeggerli/Micronaut. Cover design: Alex Wing.

In the *Scientific American* cover the magnified tip of the microscope is the only thing depicted, covering the half top part of the image. On the *Nature Nanotechnology* cover, the tip appears touching the surface of a sphere that stands out from an indeterminate mass covered with what could be described as grated cheese. While there is no text on the cover of the *Scientific American* that clearly identifies what is depicted, on the *Nature Nanotechnology* cover one reads "AFM in cancer diagnosis".[7]

[7] On the contents page of the *Scientific American* a similar image appears with the caption "Magnified tip of an atomic force microscope". The words 'Nanoprobes' and 'Atom-Moving Tools' that appear on the cover could be

Readers of *Scientific American* who may be knowledgeable about the fact that special microscopes are required to 'see' as it were the nanolevel by 'touching' the surface of atoms, could identify the image on the cover as the magnified tip of such a microscope. The rest, however, would have to make associations based on the shape, colour and framing of that image to arrive at assumptions about what it depicts. At best one could think of a highly stylized depiction of the swirl of a hurricane, but the difficulty of making any connection between hurricanes and the topic of the special issue being nanotechnology would leave one wonder about the relevance of the image. This said, the image together with the titles announcing the topics covered in this special issue would definitely raise the reader's curiosity. Nanotechnology is not only announced by the word 'nanotech' appearing in big white capital letters in the middle of the image, but also visually enhanced by the tip of the microscope directly pointing at it, which literally functions as a visual flag directing the reader's attention to the topic of this special issue.

The readers of *Nature Nanotechnology* would identify the image as depicting the tip of an atomic force microscope even without the verbal caption on the cover. However, it is unclear whether all readers would identify the orange sphere protruding from the red mass covered in white grated cheese as a cancer cell protruding from a malignant cluster, without the heading "AFM in cancer diagnosis".[8] What is important here is that, dissimilar to the image on the cover of *Scientific American*, a process is depicted with great detail that does not merely seek to raise the reader's interest but to illustrate the method carried out in the research article featured on the cover. While the sole image of the magnified tip of the atomic force microscope was enough to attract the general audience of a magazine such as *Scientific American*, the image on the cover of *Nature Nanotechnology* illustrates the actual use of the microscope in diagnosing and characterizing the progression of cancerous cells, something which is of importance for the specialized audience of this journal.

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identified as referring to the image only by those familiar with this topic or after having read the articles inside.

[8] A long explanatory text on the inside page of the journal summarizing the main point of the article from which the image was inspired provides the necessary background for better understanding it. See http://www.nature.com/nnano/journal/v7/n11/covers/index.html (last accessed 7 September 2017).

As a second example, I compare the covers of the science magazine *Popular Science* and of the scientific journal *Science* depicting the precision-guided cure of cancerous cells (see Figure 5 and Figure 6, below).

Figure 5 – Cover of August 2006. Cover illustration: Nick Kaloterakis.

Figure 6 – Cover of December 2013. Image: Valerie Altounian/Science.

The readers of *Popular Science* could effectively combine the information provided by the title "Precision-guided cancer cures" and the image to arrive at the conclusion that what is depicted on the cover is a cancer cell. However, it would take extra knowledge and reading of the short description about the cover on the contents page to identify the spherical objects surrounding the cancer cell as nanoparticles that can attack / cure cancer with precision. The image on the cover of

Science is more detailed when compared to that of *Popular Science* but not necessarily more self-explanatory. Even members of the specialised audience that *Science* addresses may need to read the short text about the cover in order to identify the pink peanut-like objects at the left side as antibodies, and the big spherical object at the right as a T cell, which once in contact with the antibodies will be activated to attack a tumour cell.[9]

From the above brief discussion of the two examples, some preliminary observations can be drawn about the argumentative use of nano-images in the front covers of scientific journals and science magazines with reference to Relevance Theory's distinction between explicit and implicit content. The image on the front cover of both types of publication functions first and foremost as a 'visual flag' that attracts the reader's attention, and thereby conveys a presumption of optimal relevance to the reader/viewer, namely that: a) The ostensive stimulus is relevant enough for it to be worth the addressee's effort to process it; and b) The ostensive stimulus is the most relevant one compatible with the communicator's abilities and preferences (Clark, 2013, p. 32-33). This means that the interpretation of the use of a particular image on the front cover depends both on the cognitive effort and processing abilities of the receiver, and on the degree to which the image-maker has chosen to make manifest his/her communicative intentions (ideally seeking to minimize the processing costs for the receiver). The first aspect can be related to the different backgrounds and interests of the readers of the respective publications: general audience with an interest in science and technology in the case of science magazines, compared to a specialized audience, knowledgeable about research in nanoscience and nanotechnology in the case of the scientific journals. The second aspect can be related to the detail and artwork that the images used in the two types of publication exhibit.

As discussed above, in the case of science magazines, the images are more generic and lack the details that illustrate specific processes and structures at the nanolevel. However, they still require extra processing effort from the viewers, given that they depict something that is not visible without the use of special instruments and visualization software, not to mention that nanotechnology is a topic with which even the audience of science amateurs is not really familiar

[9] It is worth noting here that *Science* does not address exclusively a specialised audience of nanoscientists but of scientists in general. The text about this cover can be found online at http://science.sciencemag.org/content/342/6165 (last accessed 7 September 2017).

with, because it is least discussed, compared to astrophysics and genetic biology, for example. The readers of science magazines would therefore most probably draw on associations with familiar patterns and structures from the macro world, such as landscapes and natural objects based on the colours and shapes they see in these images. As a result, more pragmatic inferences will be required on their part to arrive at an interpretation. Drawn by the aesthetic properties of these images, the readers of science magazines will thus recover implicatures concerning the wonders of new technologies and evaluative appreciations of technological progress and its applications.

The images on the front covers of scientific journals, on the other hand, are in principle the product of specially commissioned cover designers and illustrators, and they exhibit more detail. The expert viewers of these front covers are in a better position to recover explicitly communicated propositions based on what is depicted on the image, given their familiarity with the specific research area as well as with the use of colouring and other visualization schemes that are applied. This said, because of the artistic nature of some of the images appearing also on the covers of scientific journals, the cost for recovering the explicatures may at times be relatively high (for science experts who are not necessarily familiar with the specific area of nano-research, for example). In the end, the readers of scientific journals will be able to recover implicatures that go beyond the admiration of the wonders of technology, and concern the innovativeness and applicability of the research featured on the cover, basing their inferences on the explicatures recovered concerning what is being depicted on the cover.

5. CONCLUSION

In this paper, I have proposed applying Relevance Theory's distinction between explicitness and implicitness to instances of argumentative communication where image and text combine to convince the addressee of a certain claim. I have focused on the multimodal genre of the front cover whose argumentative goal can be described as seeking to promote the specific issue of a magazine. The front covers of science magazines and scientific journals, in particular, function primarily as 'visual flags' seeking to invite the reader to buy or read the specific issue, without expressing any further standpoint regarding the cover story/research. The focus on the use of nano-images, namely aesthetically enhanced images of nanostructures, raises interesting

questions as to what is explicit and what implicit, and for whom, when comparing the different audiences that science magazines and scientific journals address.

From the observations drawn after a brief review of various covers of these two types of publications, and from the preliminary comparative study of four covers featuring related topics, it is suggested that the readers of science magazines would mainly recover implicatures concerning the wonders of nanoscience, while those of scientific journals would recover implicatures concerning the innovativeness of the nano-research reported, based on explicatures recovered from the content of what is depicted on the cover. These qualitative observations could form the basis for an empirical study concerning the interpretation and reception of nano-images in the front covers of these two types of publications. Such a study would not only compare the actual inferencing processes of different groups of readers, but would also help to answer questions about what claims and arguments actual audiences of these publications recover. Another direction for further research concerns the study of the dynamic ways in which the reader of a magazine may construct an argument while browsing through its pages, thereby making connections between the image on the cover, the explanatory text accompanying it, and the presentation of the featured article inside the magazine.

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