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From Science in the Papers to Science in the News

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1. Science, Persuasion, and Rhetoric: The Argumentation Model

In this article, we argue that the communication of science in mass media operates as a kind of 'soft' or 'lite' version of scientific papers. Such common occurrences result in a significant misunderstanding of science. In order to explain why this occurs, it is helpful to analyze the nature of scientific papers as acts of communication and contrast its main differences with mass media.

According to a traditional, positivistic conception of science, the main difference between scientific discourse and other forms of public communication (literature, religion, political discourse, journalism) was that the former aims at being absolutely objective, logical, impersonal, rational, whereas in the other cases there is ample and substantial space for subjectivity, passion, and even strategy. Science pursues truth, whereas 'literary' communication aims at persuasion, or so it was thought. This vision of science, however, has been discredited thanks to lots of studies about the way real, flesh and bone scientists construct their writings, organize the research processes leading to their papers or books, employ the writings of their colleagues, and interact with agents outside the field of 'pure' science. Science, in a word, has also its own rhetoric: in the last decades, a systematic attempt to study the process of scientific communication as an exercise in the strategic use of arguments has been carried out by a number of authors, leading to the conclusion that rhetoric (in this sophisticated sense) is not only present within science, but essentially belongs to its very core).[1] A deep disagreement still exists, nevertheless, about the consequences we must draw from this fact: for some philosophers, the idea that scientific assertions are highly malleable may be dangerously close to the thesis that scientists systematically deceive, and so, a big part of contemporary research in epistemology might be interpreted as an inquiry into the (internal or external) *limits* to scientific rhetoric, i.e., into the cognitive or institutional mechanisms that may drive arguments in an epistemically 'sound' direction.[2] On the other hand, some sociologists, deliberately equating the notion of 'fact' with that of 'what scientists take to be a fact', have concluded that, since scientific *assertions* are the result of a 'rhetorical negotiation', so are the facts those assertions aim to represent.[3]

[1] See, e.g., Harris, Randy A. (ed.). *Landmark Essays on Rhetoric of Science. Case Studies*. Mahaw, NJ: Lawrence Erlbaum, 1997.
[2] Kitcher, Philip. "Persuasion." In *Persuading Science: The Art of Scientific Rhetoric*, edited by Marcello Pera and William R. Shea. Canton (Ma.), Science History Publications, 1991; Goldman, Alvin. *Knowledge in a Social World*. Oxford: Oxford University Press, 1999.
[3] Mulkay, Michael J. *Sociology of Science. A Sociological Pilgrimage*. Milton Keynes: Open University Press, 1991.

One of the authors of this article has developed in a series of papers[4] a model of the process, scientific research and communication that attempts to mediate between both approaches: the aim of a scientific paper would be to *persuade* the author's colleagues of using and citing the results presented in the paper, but in order to be capable of doing that, the author must justify those results according to some inferential (logical, methodological, rhetorical…) *rules* that have been agreed (ideally) by all the members of her research community, and that have been designed or selected in big part (but not exclusively) because of their efficacy in leading to results that have *nice epistemic properties*. One of the most important social implications of this view is the manner in which the rhetorical (i.e., 'leading to persuasion') aspects of the paradigmatic piece of scientific communication (i.e., the scientific paper) relate to the rhetorical elements of the main channel through which science reaches the general public, i.e., journalism.

According to our 'persuasion model' of scientific communication, a paper is basically a piece of *argumentation* (rather than a piece of *information*). This means that the goal of the publication is to persuade the readers to *do* something; in particular, what the author wants the referees to do is *accepting* the paper for publication, but most importantly, what she wants the 'regular' readers to do is *quoting* it in their own future papers (mainly quoting it as containing information relevant for some premise these other papers consider to be useful to introduce as a means of persuading their readers of the validity of *their own* conclusions). All this traffic of conclusions-premises depends on the fact the scientific community to which the authors of the papers belong basically agrees on some (more or less tacit or explicit) rules saying when it is *legitimate* to conclude some claim on the basis of other claims. Of course, there can be more or less strong debates about the content and use of these rules, but these debates must depend in their turn on some other shared rules or intuitions about the soundness of the inferences. But, for the most part, 'normal' science (to use the famous Kuhnian term) flows over a more or less stable bedrock of agreed inferential rules within each specific research community.[5]

2. Journals and Media as Different Games

Communication between specialists through scientific papers is, obviously, a very different kind of activity as communication to the general public through the media. The fact that (for example, if we concentrate on science news in printed newspapers) both types of communication seem to consist after all in the written transmission of a bit of scientific information, has traditionally led many people to conceptualize a piece of science news as a kind of 'degenerate', 'simplified' or 'imperfect versions' of a scientific paper (a concept as misguided as Aristotle's view of females as 'imperfect versions' of males). From this deeply mistaken way of understanding the relation between both forms of writing, the prejudice has been created that the 'more faithful' science news are to their

[4] E.g., Zamora Bonilla, Jesús. "Scientific Inference and the Pursuit of Fame: A Contractarian Approach." *Philosophy of Science* 69 (2002): 300-323; Zamora Bonilla, Jesús. "Science as a Persuasion Game." *Episteme* 2 (2006): 189-201.
[5] For a succinct categorization of the inferential rules used in science, see Zamora Bonilla (2006).

original scientific 'source', the better, at least from the point of view of information, and hence every aspect of the science news that helps to fit them to the peculiar needs of the media has been seen as a something like a 'cost', a 'necessary evil'. But professional scientific communication and science journalism are in fact two completely different kinds of 'game'; they are just as different as sports or politics are from journalism. If we consider the scientific paper more as a type of intermediate product of the process of *research* than, so to say, as a piece of *communication* in the abstract, the difference is clearer. The 'ultimate' goal of writing a paper, its fundamental point so to say, is not just to inform your colleagues of your discoveries (though, of course, it can be used as well for that); it is to help them encourage *further* discoveries. And obviously this is not the 'fundamental' point of writing a piece of news for the media, in exactly the same way as *writing* a report on the last basketball match has not the ultimate goal of winning the NBA league, which is, instead, the goal of *playing* the match.

A better way of understanding scientific journalism is thinking about it as analogous to a variety of sports journalism, rather than as a 'popular' way of rewriting scientific papers. Of course there are lots of important differences between science and sports, and between both related types of journalism, but we suggest that a more faithful and useful understanding of science journalism can emerge from looking at its similarities and differences from sports journalism (or other types of journalism), than from concentrating on how more or less faithfully it delivers the contents of scientific papers. This will of course be a more or less important concern depending on the circumstances, but we think it is helpful not to concentrate on it as the *essential goal* of science communication in the media. The idea is not to think of objectivity as something every 'cut' from it counts as a cost, but simply as something we need at least a certain *minimum* amount of for the article, piece of news, report, etc., to 'function well', in combination with a lot of other very different things we also need a minimum thereof.

From the point of view of our argumentative model of scientific communication, this means that the rules scientists need to obey in their professional writings (see section 1) *need not be the same, nor even similar*, to the ones preferred in science journalism, as the rules of basketball are not even similar to the rules of basketball journalism. Writing news is a completely different game from writing a scientific paper, and in order to satisfy *its own* goals, it needs different principles from the ones of professional scientific writing, nor just a 'simplified' version of them.

3. Scientific Relevance vs. Media Relevance

The media culture has its key when selecting information. What is relevant scientifically does not have to be from a journalistic point of view, nor vice versa. For example, the Sun is much more important than Mars to anyone living on Earth. Not only because the Earth rotates around the Sun -or their role in plant photosynthesis-, but, for example, because even small activities such as solar storms can affect satellite communications. Mars, instead, is inert and, if it disappeared, probably the Earth would continue to

survive. However, news concerning Mars is more often read than news about the Sun. Why? Because Mars has a literary component, of lost civilizations for example, which makes it extremely attractive to news reporting or subject of a documentary.

With this example we can see what is most interesting for the media, does not have to be the most relevant piece of information to science. However, this is not the main difference. The sharpest boundary that separates science from journalism or disclosure is language: very often it is just impossible to describe, in a language the public of the media can understand, the content of most scientific papers or specialized books or reports, which use an increasingly hermetic language that specialized researchers need to create in order to express in detail and with logical and mathematical fruitfulness the theories, laws and data with which they describe the world.

Terms such as telomeres, black holes, pulsars, chlorofluorocarbons, quark, gravitational lens, development gens, cloning… they are difficult to understand for a person with an average level of education. Not only that, scientific terms are obscure for the lay public not for how they sound, but just because of the reason why they are created by scientists in the first place: because these concepts encapsulate a network of meanings (i.e., potentials for logico-mathematical inference) which depend on the often complicated theories those concepts belong to. The reality in science is that most of their expressions don't have synonymous in everyday language, nor even terms with a more or less close meaning. And the problem gets worse because since the twentieth century there has been a gradual distortion of the concepts and logic employed in many scientific theories, especially in the physical sciences, with respect to the basic intuitions of common sense: the space of four or more dimensions, antimatter, light attracted by black holes or clocks that forward or delay according to the Theory of Relativity. All these concepts are very difficult to understand for a non-expert mind, but it is even more difficult to explain them and make them attractive to the audience of the mass media.

Just to offer an impression of this fact, we can mention Nicholas Russell, according to him "in the past the language scientists used to write about science was similar to the language in newspapers and magazines (Russell 2010, 18)[6]". So, in this sense, the peculiar language of modern scientific research is relatively new. "It is not just that there is a lot of scientific jargon and the topics are unfamiliar. There is something about the structure of the language of modern professional science that makes it hard to understand (Russell 2010, 18-19). Actually, this can be measured in an objective way: Donald Hayes has compared samples of writing from scientific journals with other forms of writing since 1900 (Hayes 1992)[7]. He uses a lexical analysis of word difficulty to compare articles against a "standard" whose reading difficulty has been constant over a century; international English newspapers. These newspapers give a constant score of zero. Texts that are more difficult to read are rated with positive numbers; those that are easier are

[6] Russell, Nicholas J. *Communicating Science. Professional, Popular, Literary*. Cambridge: Cambridge University Press, 2010.
[7] Hayes, Donald P. "The Growing Inaccessibility of Science". *Nature* 30 (1992): 739-740

negative. According to Hayes, in 1930 three of the primary magazines of science communication –*Nature*, *Science* and *Scientific American*- all had lexical score around zero, they were no more difficult to read than newspapers, but by 1990 *Nature* scored an average of +30, *Science about* +27 and *Scientific American* +10.

4. The Peculiar Language of Modern Science Research

We will try to explain in this article how the mass media principles work to select and publish science news. What are the main differences between scientific language and the language of journalism? In fact, science journalism can be defined as a work of translation. But it is not a simple translation between two literary languages (from Spanish to English, for example); it is a translation between two languages that have developed since the beginning for different purposes.

Scientific language tends to employ a system of abstract signs such as those of Mathematics, Chemistry or Symbolic Logic. The ideal is the universal language that Leibniz had begun to project, in the late Eighteenth century, in his *Characteristica Universalis*. The ideal, for developers of scientific language, is to write a comprehensive scientific text without using any terms of "inaccurate" vocabulary of literary language. This is so much so, that if we observe what is written on a blackboard after a class of Organic Chemistry or Quantum Mechanics, it can be very difficult to know the native language of the professor that was just teaching that class.

For the purposes of scientific research and professional science communication, literary language is often deficient in certain respects. It abounds in ambiguities and, like any other historical language, is full of homonyms, arbitrary and irrational categories such as grammatical gender. Others elements are clearly unscientific: for example, in most current languages people still say "Sunset" or "Sunrise" when in fact, we know exactly since Galileo that the Sun does not move. It's Earth that does.

Literary language – as used in journalism and media communication – is permeated with historical accidents, memories, associations… in a word, is highly connotative. On the other hand, literary language is far from being merely signative. It is expressive, it also describes the tone and attitude of the speaker or writer, much more so than scientific language; and a phrase does not simply express what it explicitly says, but usually wants to influence the reader's attitude. Literary language seeks to persuade the reader, and ultimately make him change; we have seen that to a big extent this is also true of the professional scientific texts, in spite of the prevalent positivistic prejudice to the contrary; but the difference mainly concerns about the *object* of persuasion in each case: a scientific paper tries to persuade its readers to cite it and use it, it is an instrumental persuasion, so to say; whereas a literary text, for example a media article or report, tries to persuade its reader of the *emotional interest* they should put into the content, not to *do* something else with it (though, of course, this is something that can happen as well, but it is not the essential goal); literary persuasion is usually *emotional*, rather than

instrumental. Furthermore, the literary language emphasizes the sign itself, in the sound symbolism of the word. To call attention to it have been invented techniques such as metric, prosodic, alliteration and phonetic scales, that obviously connect in an unconscious way to the reader's emotional fibers.

Scientists hate the sound of symbolism, the expression of their own opinions and thoughts on a particular topic (or so they want to believe), and praise instead symbolic logic. Journalists, on the contrary, seek not only the literary beauty of their writings, but even attempt to emulate literary archetypes; for example, the stories expanding on the archetypal "mad scientist" make more room in the media, because to some extent they are an update of the literary character of Prospero in *The Tempest* by William Shakespeare (Sontag, 1977)[8]. Journalists also seek above all, persuade with their message, not necessarily with its truth. That does not mean that they consciously want to deceive the audience, just that their main goal is often not that of transmitting objective information, but that of capturing the motives why something is interesting for the public, even if those motives refer to an aspect of the events that are not exactly the ones considered more important by the scientists, and even if the expression and transmission of those motives demand to construct a distorted, *caricaturesque* image of those events.

According to John C. Burnham, in his interesting book *How Superstition Won and Science Lost* (1987)[9], "they [science and journalism] are two of the most important facts at the present time. But their worlds are not similar. Few newspapermen are interested in a scientific finding unless it can cure cancer while in orbit. Few academicians are interested in press coverage unless the facts are expressed in mathematical Latin and are heavily qualified to prove that nothing really important happens (Burnham 1987)". Unfortunately, we may add, in the decades since this was written the number of academicians actively looking for press coverage has grown.

On the other hand, according to Jon Franklin[10], a scientific journalist for more than 40 years who won two Pulitzers and also the gold medal from the American Chemical Society, "after World War II the schism was exacerbated by the pace of technological events. By 1960 it was palpable even at academic reception. The rift was definitely there, and it was definitely increasing, and while we may argue about the social seismology involved there is one thing that any science writer can tell you for certain. And that the laboratory was on one side of the fault line, and the newsroom the other" (Franklin, 1997).

[8] Sontag, Susan. "The Imagination of Disaster." In *Awake in the Dark: An Anthology of American Film Criticism, 1915 to the Present*, edited by David Denby. New York: Vintage Books, 1977.
[9] Burnham, John C. *How Superstition Won and Science Lost. Popularizing Science and Health in the United States.* Rutgers. Chicago, 1987.
[10] Franklin, Jon. "The End of Science Writing." The Alfred and Julia Hill Lecture: University of Tennessee, 1997 (published in *Quark* in 2000).

In a lecture Franklin gave, he explained his view of how the perception of science has changed from World War II to the latest nineties:

> In the late 1970s I was forced to rethink my journalist strategy. I had been reporting and explaining discoveries, but my stories were not being widely read. I generally used the word "science" early in the story, thinking it would attract readers. The word generally ended up in the headline. But I now realized that the effect was to tell general readers what to avoid. They might trust science in theory, but in practice it had bad personal association. Science pages ghettoized science news, gave people a whole section they could throw away unread. There was something more sinister afoot, as well. As attitudes changed, editors started wanting a certain negative spin on science stories. If you didn't comply you got played inside, or your existence was otherwise made uncomfortable. Some science writers, especially those who identified with the ecology movement, saw hostility to science as a path of success. (Franklin 1997)

On the other hand, according to Franklin, many reporters, decidedly neutral on their topics, found it easy to align themselves with the anti-science faction. This was often couched in terms favouring plurality and an openness toward "other ways of knowing".

5. Structural Differences Between a Science and a Newspaper Article

Researchers like Georges Mounin explain that translation is not merely a lexical problem. According to him, we translate messages and not languages. These messages have their structure, context and co-text: these are what truly constitute their meaning, and not the individual terms that define them (Mounin 1963)[11].

In the classic textual analysis, we can observe that the typical structures of journalistic news and scientific papers are clearly different (Van Dijk 1983)[12]. According to the textual scheme of Van Dijk, journalistic news are divided into:

> a) **A summary**, the Anglo-Saxons call "lead", and should answer the key questions: what, who, when and where.
> b) **A narrative corpus** which integrates episodes and conclusions. This narrative corpus –the story- may be dominated by an anecdote as literature usually does. And, of course, may lack scientific significance.

By contrast, the prototype article written by a scientist has an argumentative-narrative structure, which is reflected in its organizational units: it develops into a problem

[11] Mounin, George. *Les Problemas Thèoriques de la Tradution*. París: Gallimard, 1963.
[12] Van Dijk, Teun. *La Ciencia del Texto*. Buenos Aires: Paidós, 1983.

statement and, in the end, the solution is provided. In this sense, the sequence is typically the following:

> **Summary**: provides an index of what address the item. (By contrast, in journalistic terminology, summary means typographically highlighting a sentence).
> **Introduction**: discusses why this topic was chosen for investigation. Explain the scientific theory behind the proposal and the research objectives.
> **Background:** explains similar researches that have been conducted previously and tries to establish why the research that appears in our article is original and why it should be published.
> **Method**: This is the most important part of any scientific article. Modern science is aware that its great triumph is its methodology, even more than the results: it is the "scientific method." For journalists this is irrelevant, because they only seek results to write the headline. The method is not news itself, because, usually, the methodological approach is always the same; unless there is a breakthrough in the methodology itself.
> **Materials**: listing all instruments, chemicals, etc. used in research, so that the experiment could be easily reproduced. Specific instruments or substances are described in great detail in many cases. In medical research, the materials can be their patients
> **Results**: the specific findings obtained after the application of the methodology to the materials employed.
> **Conclusions**: this refers to the main contribution of the paper, which confirms or denies the preceding investigations.
> **Discussion**: this references and contextualizes what the results mean in a broader context, especially based on the general theory. It can also address the difficulties of research as well as advice future lines of research to confirm or disprove results.

From the point of view of journalists, only the results are worth it. The rest – discussion, materials, methods, etc. – is usually irrelevant to the story that the media need. However, there are factors that will never appear in the scientific paper and are very journalistic: for example, if there has been an internal conflict among researchers, or a dispute with the dominant professional ethic, etc. And of course, it helps to be elected as a news story if the results support the Western literary tradition which holds that unlock the secrets of nature can be dangerous for humanity, from the Greek myth of Prometheus, to the medieval Faust or Frankenstein in the early nineteenth (see section 7).

This is neither good nor bad: it is only our Western cultural tradition. And do not forget that the same cultural tradition also created modern science. Journalism is a literary genre; therefore it is inspired by the literary tradition: adapting characters, myths, histories and literary masterpieces that have been successful. And other mass media such

as film or television work similarly when addressing science stories. This view of the western literary tradition (contrary to science and fearful of how discoveries can affect humanity) has been massively disseminated by the media. And this may be one of the causes that explain the alarming decline in young vocations in science and engineering in Western countries (Elias 2011)[13].

On the other hand, the journalist who write scientific news should always make clear the answer to two key questions: why is this important? And especially, why should I publish it? And, at the same time, she also must answer two other important questions: why did I choose this story among all the news that occurred today? And why you (reader / viewer / listener) should read this piece of news? These are very different that the questions scientists take into account when choosing a field of research, and usually when communicating their discoveries out of the properly scientific circles.

6. How to Write a Newspaper Article From a Scientific Paper

Writing a text of science journalism is an exercise in creative writing; therefore, there are no clear rules on how to address it: everything depends on the talent of the journalist. However, some recommendations should be followed. First of all, journalists should read the research paper and select only three or four main ideas. According to journalism theory, they should ignore the rest of the article. Do not forget that science journalism, as every discourse with literary language, is not intended to rationalize a fact, but aims most importantly to emotional persuasion, and persuasion is more effective if few ideas and data are selected and repeated eloquently. This may not be the ideal from the point of view of pure logic, but it is how the human mind works, and it is a claim that can be traced backed even to Aristotle's *Rhetoric.* (Elías 2008)[14].

But this is not negative *per se*. It is precisely because the journalism uses elements of rhetoric, that science can reach large audiences. Scientists criticize this strategy. They believe that a news story, or a movie about science, is at an intellectual and creative level below the science paper. They consider the journalistic piece as a crude copy of the 'original' scientific paper. But science journalism can also be first-rate intellectual creation. And it not only serves as a piece of entertainment and information, but even helps make science known and admired beyond the laboratory. Sometimes, though, also extending a negative image. In any case, the scientific culture of public opinion not only comes from schools and universities; it also comes from how the media published stories about science and scientists.

From the field of science, researchers often criticize the vagueness of the language used by the media, because it lacks the technical vocabulary that avoids misunderstandings in

[13] Elías, Carlos. "The Decline of Natural Sciences in the Culture of Mass Media." Proceedings of the International Astronomical Union 5 (2011): 393-404. doi:10.1017/S1743921311002572.
[14] Elías, Carlos. *Fundamentos de Periodismo Científico y Divulgación Mediática*. Madrid: Alianza Editorial, 2008.

science. However, this lack of jargon is not an absolute limitation and can be mitigated by the creation of a new discourse in which scientific terms charged meaning, regain their sensory and above all, reveal its relationship to the reality shared between scientific and newspaper readers. Achieving this goal would be the transcoding process performed by science popularizers: from journalists to film makers. They have an arsenal of resources, well known since the time of classical rhetoric: from synonymy or analogy to metaphor, example or definition. They are used in the press and on radio and television.

7. Science in Cinema and TV

Mass media is not just journalism. It is, above all, film and television. What is the image that cinema and TV broadcast to society about science and scientists? Since times as early as 1978 scientists at a an annual symposium of the American Association for the Advancement of Science (AAAS) agreed that the popular image of scientists is remarkably bad, and that the mass media must bear a great deal of the responsibility (Maugh 1978)[15]. It is very well studied and established that most fiction films depict scientists as the mad archetype: "Without doubt, Dr. Frankenstein is better known today than any other scientists, living or dead", writes George Basalla[16]. Movies and television portray scientists as "frequently foolish, inept or even villainous."

Scientists often appear as Satanists or Faust-like figures in the movies. Even in the movies of the '30s and '40s there are a number of easily recognizable characteristics. The scientist is usually an elderly white male. He may be insane or evil. But since the 1950s, the cackling madman hatching plots to rule the world has more or less vanished from the screen. In films of last 50 years, the scientist is not always a white male, but often is well-meaning yet obsessed with the pursuit of knowledge. Amoral rather than immoral, he will stop at nothing to find out what he wants to know. He will not let human sensitivities or sympathies stand in this way. He displays his insensitivity in small ways. If the scientist has family, he usually neglects them. More often, scientists in the movies are shown to be bachelors or widowers. They are rarely shown as being sexually or emotionally involved. The audience may hear the scientist's beautiful daughter or assistant say that he is married to his test tubes.

However, the scientist's capacity for destruction on a large scale is the major recurring theme in the films. As Susan Sontag notes, "science fiction films are not about science. They are about disaster, which is one of the oldest subjects of art. In science fiction films disaster is always extensive" (Sontag 1977). However, the scientist's capacity for causing disaster has increased since the 30s to present time. In the horror film of the '30s the worst a scientist could do was lay a small Bavarian village to waste. But more lately

[15] Maugh Thomas H. "The Media: The Image of the Scientist is Bad." *Science* 200 (1978): 37.
[16] Basalla, George. "Pop Science: The Depiction of Science in Popular Culture." In *Science and its Public: The Changing Relationship*, edited By Gerald J. Holton and William A. Blanpied. Boston: Reidel Publishing, 1976.

they have the power to imperil the world (*The Core*, Jon Amiel 2003), or even many worlds.

Note that the scientist most often wreaks havoc by building or creating something. The process of scientific research is rarely distinguished from the process of technological application. In cinema they are usually one and the same.

B-films of the '50s reflected the fears of that time - nuclear war, dehumanization and political subversion - in the same ways that films of the 90's and 00's reflect the fear of genetic manipulation. The point is that the one responsible for the process of dehumanization is the scientist.

Of course, scientists were often seen as responsible for the sudden appearance of monsters. In the fifties prehistoric monsters were awakened through nuclear testing. In the nineties and present times monsters are resurrected through genetic manipulation, as seen in *Jurassic Park* and *The Lost World*.

Scientists have also played an important role in the many alien invasions and infiltrations portrayed in films. The aliens, cold and implacably hostile, either bring ruin to the world with flying saucers and ray guns, or take over the minds of humans by remote-control. Despite this, the foolish scientist always wants to communicate with the hostile invader, while the military men wisely see the menace and try to destroy the creature.

This association between scientists and "non-human behavior" is easy to find in the culture of mass media. One of the better examples is Star Trek, where Leonard Nimoy played the Enterprise's "Science Officer," one Mr. Spock from the planet Vulcan. The inhabitants of Vulcan learned to suppress emotions, and for much of the series, Mr. Spock was a relentlessly rational, typically heartless scientist.

It is very interesting to see how the rise of contemporary science and technology coincides with that of a popular culture led by the mass media and in which the image of the scientist usually is very negative. In present mass media culture scientists are treated as evil and, while, on the other hand, athletes are called heroes. However, elite athletes are dispensable for the social, economic and intellectual development, whereas scientists are essential for progress. Exactly the same can be said about rock stars, for example.

All Western children know the names of the players from different sport teams, but usually ignore the names of any scientist from their countries. This is also reflected on the alarming crisis of vocations of young people wanting to become scientists. And in this sense a big part of the responsibility lies with the media, especially television. Journalism has been for more than a century a reliable ally of sports in the promotion of the social and cultural image of athletes, but unfortunately we cannot say the same about the relation between journalism and science. Perhaps a rejuvenated view of the relation

between science journalism and sport journalism (as we suggested in section 2) could help to solve this problem.

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