

**Graphical Argument in the Essayist Prose of the *Pesquisa FAPESP*
Journal / *Argumentação gráfica na prosa ensaística da revista Pesquisa*
FAPESP**

*Irene Machado**

ABSTRACT

This article¹ investigates the concept of graphical argumentation as an exercise of essayistic prose developed in the process of writing expansion in printed texts. It is understood that by expanding the scope of the word in the context of visual graphics processes such as drawings, photography and infographics, arguments are achievements much more of diagrammatic reasoning than of rhetorical elaboration. Proof of that are graphic arguments, which have become an inalienable modeling from texts of scientific communication, such as the ones produced in the *Pesquisa FAPESP* journal.

KEYWORDS: Graphical Argumentation; Essay; Prosiness; Modelling; Diagram; *Pesquisa FAPESP*

RESUMO

O artigo explora o conceito de argumentação gráfica como exercício da prosa de caráter ensaístico que se desenvolveu na expansão da escrita em textos impressos. Entende que ao ampliar o escopo da palavra no contexto de processos gráficos visuais como os desenhos, a fotografia e os infográficos, os argumentos são muito mais realizações do raciocínio diagramático do que das elaborações retóricas. Prova disso são os argumentos gráficos que se tornaram modelizações inalienáveis dos textos da comunicação científica, tais como produzidos na revista Pesquisa FAPESP.

PALAVRAS-CHAVE: *Argumentação gráfica; Ensaio; Prosificação; Modelização; Diagramas; Pesquisa FAPESP*

* Universidade de São Paulo – USP, São Paulo, Brazil, CNPq – PQ no. 306871/2006-8; irenemac@uol.com.br

¹ The article synthesizes results from the study *Língua entre linguagens: Argumentação gráfica nos textos da comunicação científica* [Language between Languages: Graphic Argumentation in Scientific Communication Texts] (CNPq, PQ 2007-2010), whose final version was presented as Associate Professorship Thesis in Sciences of Communication at the School of Communication and Arts [Escola de Comunicações e Artes], University of Sao Paulo, 2011. A preliminary version of the analyzed data is included in the article *Argumentação gráfica: a modelização diagramática na comunicação da ciência* [Graphic Argumentation: Diagrammatic Modeling in the Communication of science], presented at the 2nd Conference Communicating Science, Universidade da Beira Interior, Covilhã, Portugal, May 2015.

Introduction

This paper follows and discusses the process in which the graphic-alphabetic codes are amplified into graphical print languages due to the expansion of writing, and because of this they modify the cultural nature of communication by language. In this scenario we have seen the flourishing of both prose and forms of reasoning whose graphic nature is far from being opposed to the poetic oral-aural forms. We refer here to the analytical processes that moved interpretive faculties and turned the whole argumentation process into experimental work that takes the dialogics of the encounter with the other inserted in the forms of conversation to the ultimate consequences. However, instead of the suasive rhetorical play, the emergence of metalanguage takes place, and graphic codes draw the trajectory of thoughts in developing hypotheses and discoveries, leading knowledge to the center of the argumentative scene sustained by inferences. The suasive power gives way to the power of experimental metalanguage.

Far from seeing only a discursive rhetoric conformation, in the modeling of language observed here prose is exploited in the diversity of its articulations as essay – in the provocative thesis of Max Bense (1996). As essay, prose takes on a very different path from that laid down in the Poetics and follows the prosaic ways of engagement with discursive forms of daily life. According to Bense, it is a distinction that defines poetry as a “means of creation” and prose as a “means of engagement” (1996, p.135).² Engagement does not hide its commitment to the “ethical state,” whose main purpose is “formation, education, transformation, and revolution” (BENSE, 1996, p.135).³

Such purpose would be enough for an approximation with the higher assumptions of M. M. Bakhtin’s dialogism. Nevertheless, in prose understood as essay, we can glimpse an engagement that is aimed at the exploitation of experimental metalanguage, at formation and education in the field of specific languages observed in diagrams of graphical argumentation. Diagrams, in turn, support the construction of

² Text in original in French: “En poésie, la création est possible, en prose, fondamentalement, seul l’engagement est possible, disons, plus précisément: la poésie est un médium de la création, la prose un médium de l’engagement.”

³ Text in original in French: “J’en conclus que l’art n’intéresse que du point de vue de ce qu’il produit, et que chaque stade esthétique qu’il suscite constitue de toute évidence une approximation de l’acte créateur, tandis que le stade éthique n’a rien à voir avec la production, mais se tient sur le plan de la formation, de l’éducation, de la transformation et de la révolution.”

philosophical, scientific and even pragmatic knowledge, when considering the field of processes introduced by the languages of the media.

We may then complete the reasoning previously introduced. The suasive power gives way to the experimental metalanguage of graphical languages designed as thinking diagrams in which prose emerges as essay sustained by graphical arguments.

Consequently, there emerges a field of discursive relations outspread through at least two semiotic domains: that of the artificial languages of science and that of the communication of findings and inferences. Both are engaged in the construction of the process of science communication through experimental metalanguage. On the one hand, it is about exploiting the diagrammatic composition of graphical arguments, and on the other, about turning this experimental metalanguage into a critical exercise of semiotic-scientific education and formation. Prose as essay fulfills its ethical and dialogical engagement guided by the conscious exercise of language and justifies the field of discursive relations in science communication.

Given the above considerations, it should be added that the present study advances against the common sense that understands products and processes of science communication as an activity of simplification of reasoning and language in order to turn such particular subjects easily understandable. Against this assumption, we raise the hypothesis that, in the hard work of building scientific and philosophical knowledge, there is only one place for engagement with complexities, which requires major investments. Instead of simplifying it in order to make communication univocal, this is about multiplying it in order to cover large spheres of complexities and make them sources of improvements. The sole fact of recognizing the difference between the dissemination of science practiced among peers and the circulation aimed at a broad and heterogeneous circuit of people justifies the scope of an exercise based on incompatible diversity, thus, with any univocal attitude of making science easy. Rather, the need for an ethical commitment to the educational engagement that only the language used in the heterogeneity of its constitution can allow is recognized. That being said, we are stepping into the context of the subject targeted in this article: the graphical argumentation designed by the prosaic orientation of science communication discourses that takes on the experimental nature typical of essayistic prose.

1 The Prosaic Nature of Graphical Argumentation

At the beginning of this paper we called on Max Bense's study on essayistic prose. Now it is time to remember that in the essay the notion that aims to improve the stylistic possibilities of prose develops a line of reasoning dear to M.M. Bakhtin. We refer to the provocative and controversial study on the decentralization process of the novelistic prose observed in the course of language stratification. During the process of prosification of culture, the varied discursive formations from different sources are introduced in the space of "expository prose" and become the novel's dominant discursive orientation (BAKHTIN, 1981, pp.379 *et seq.*).⁴ From a predicative condition – an "artistically prosaic image" (BAKHTIN, 1981, pp.277 *et seq.*)⁵ – G. S. Morson and C. Emerson (1990, pp.19 *et seq.*) derive the substantive condition and conceive the "Prosaic" as a field for the study of the discursive explosion of the emerging prose in everyday communication.

Just as the phenomenon of "prosification of culture" and its consequent bond with everyday life does not mean stylistic-compositional demotion but an investigation of discursive relations in existential contexts of diverse dialogical experiences, one cannot attribute to the phenomenon of dissemination of science and its consequent approach to the context of everyday prose – particularly that which is forged from the emergence of the mass media – a simplification of scientific experiments either. Not even the practice of popularization is limited to a reductionist conceptual key. In this sense, it is urgent that we recover the theoretical key of prose as Bakhtin conceived it in the universe of discursive forms designed by experiences in the world of everyday communication.

Considering the latitude of our hypothesis, this study aims at the theoretical-analytical investigation of the object of study that takes graphic arguments as a diagrammatic process of science communication. To do so, it seeks to examine the conceptual devices of graphic iconism – conceptual metaphors, canonical icons, and logical snapshot – beyond the simplistic denomination distinguished under the name of

⁴ BAKHTIN, M.M. Discourse in the Novel. In: _____. *The Dialogic Imagination: Four Essays*. Ed. Michael Holquist. Trans. C. Emerson and M. Holquist. Austin and London: University of Texas Press, 1981, pp.259-422.

⁵ For reference, see footnote 4.

“mere illustration” of the written text. When restoring the development of cultural devices for science communication – in the context of the ethical engagement that is enunciated – stronger assumptions challenge the horizon of our understanding. Therefore, we accept the challenge to observe how such assumptions become periodic productions of established scientific journals whose commitment is not solely to the dissemination of scientific knowledge in spheres of social circulation that are not strictly academic. We are interested in observing how semiotic processes of the media come into the realm of scientific discourse and introduce elements of discursive feedback⁶ in it. This is the keynote of the use of graphical argumentation in the essayistic prose of science communication.

In terms of feedback, the dialogic process guides the discursive relations that can be examined in the light of modeling, translation, and other hybrid discursive procedures, which are, therefore, unsusceptible to homogenization and favorable to the heterogeneity of encounters of forms in the tension of its borders.

The examination of our hypothesis will be dedicated to the analysis of a scientific journal that emerged for the dissemination of research carried out at the university, but that situates broader socio-cultural circles in the horizon of its dialogue. By following the transformations of the *Pesquisa FAPESP* journal over almost two decades of its publication, in it we find a wide field of experimentation that makes use of discourses and forms of media communication to produce its exercise of metalanguage with it. If, on the one hand, it inquires media formations, on the other, it translates them to the scientific environment and returns them under elaborations that require renewed semiotic skills from their readers.

Pesquisa FAPESP came to light in 1999 as a renewal of a journalistic bulletin⁷ for the dissemination of the enterprises of the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) [Sao Paulo Research Foundation]. From the beginning, the essential task of *Pesquisa FAPESP* was to publicize projects carried out at public universities and also in partnerships with private companies. By turning research into information news, the journal introduced a field of textual experimentation that made

⁶ Feedback in Information Theory means self-regulation, “the return of energy from a circuit’s output back to its input” (GLEICK, 2011, p.238). Here it designates the displacement of a speech from a sphere of everyday use to the scientific sphere in order to translate concepts operated by metalanguage.

⁷ *Notícias FAPESP*, August 1995 to September 1999.

the act of communicating science a major undertaking: it became a non-exclusive reference space to the scientific community, being committed to the improvement of citizens as well as of media workers. It also became a space of reference for research about the process of communicating science in different spheres of its constitution, from the modeling of visual codes to the composition of graphic arguments as a unique opportunity to explore the essayistic prose in the sense attributed by Max Bense.

Thus, the investigation of the essayistic prose of graphic arguments is organized as a result of the composition of the journal production in different spheres: covers, headlines, titles, articles, and visual images. From the combination of such forms, the plasticity of the arguments comes to light by means of the joint work of scientists, journalists, graphic designers, and photographers. Not even a cover drawn with minimalist resources (Fig.1), as it is common to the work of graphic artist Hélió Almeida, one of the journal's team of graphic and artistic designers, can be considered a device devoid of argument.

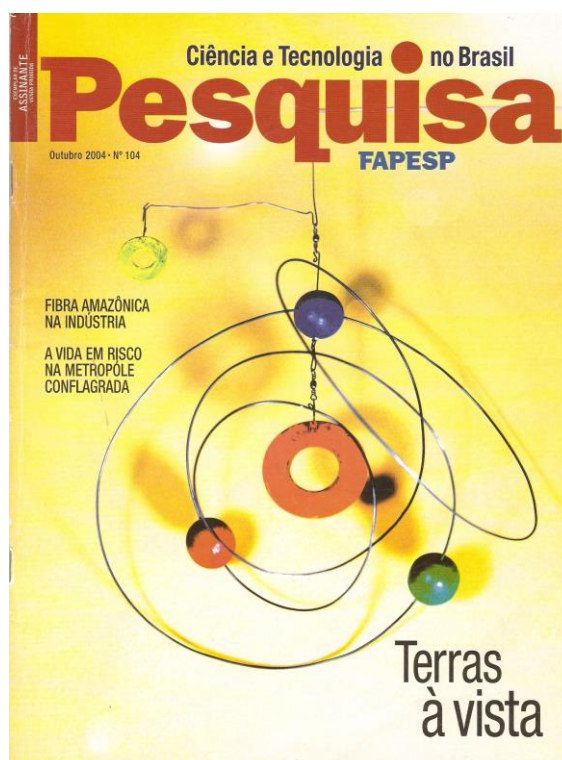


Fig.1 – Outras estrelas do mundo [Other Stars in the World]. *Pesquisa FAPESP*, n. 104, Oct. 2004.⁸

⁸ The digital version of all the journal issues is available at the website <http://revistapesquisa.fapesp.br>.

The yellowish cover thematizes the report on the research about the “discovery of the first planet outside the solar system around a star similar to the Sun” (PIVETTA, 2004, p.41; our translation),⁹ which, in a sense, is introduced in the headline *Terras à vista* [Lands in Sight] as a reference to the discovery of a rocky world similar to the Earth. When it comes into contact with the wealth of information and diversity of hypotheses surrounding the research, a further understanding of the configuration of the orbits of the planets in the form of wire that seems to be an mobile sculpture takes place. First, there is the notion that the discovered planet is solid and, similar to other planets that emit no light, it is difficult to be photographed. To meet this difficulty, scientists turn to the only resource they have to communicate what they have discovered: artistic representations (PIVETTA, 2004, p.48) – the only capable of maintaining the findings at the level of hypotheses. There emerges a conceptual argumentative kernel whose diagrammatic thread begins from the cover and runs through the other enunciative instances of the report. In this unique example, we have a sample of the dialogical process that uses feedback to return a practice under the form of thought diagram.

In graphic arguments varied forms and diagrams that result from the work of design transformation, geometric shapes, diagrams, maps, numerical formulas, and many other visual forms are not “mere illustrations,” the syntheses of a mere “for example,” in the fortunate conception of biologist Cristina Bruzzo (2004). This way, we were challenged to understand the graphic argument in the opposite side of simplifications, which includes the well-known, popular slogan that “a picture is worth a thousand words” and to face the translational processes that place the sophisticated metalanguage of science in audiovisual and infographic fields and in the field of printed graphics. In this space of semiotic reference, argumentative construction is the axis that brings together the explanatory activity of various discourses in which everything is at the service of communication and knowledge.

⁹ Text in original: “descoberta do primeiro planeta fora do sistema solar em torno de uma estrela semelhante ao Sol.”

2 Modeling of Graphic Language

Experimentation constitutes the key to laboratory scientific work, be it in the empirical-conceptual field or in the pragmatic-communicative one. It is not surprising that it plays a major role in the creation process of the graphic language of the *Pesquisa FAPESP* journal. Experimentation mainly occurs in the exercise of metalanguage that puts into action forms of drawing, photography, fine arts, design and computer graphics as well as the codes of artificial languages, particularly images from microscopes, telescopes, satellites, and computers used in scientific research. From this array of resources, graphic language modelizes the codes that it uses in order to build arguments specific to each text.

Modeling is a semiotic concept forged in the field of computing to understand the occurrence of language in systems that do not utilize verbal signs. It lends itself to the understanding of languages that, in the cultural system, are built with the diversity of iconic signs of visual plasticity or with kinetic signs of the audiovisual media. The notion of model arises from the dynamics that attributes the condition of language outside the language structure, as we can read in the formulation of Viacheslav V. Ivanov:

Like other sciences related to cybernetics, semiotics is concerned primarily with models, i.e. with forms reflecting (modeling) objects, forms composed of a finite number of elements and relations between these elements. [...] The construction of models of the world is effected by means of semiotic modeling systems with varying degrees of modeling capacity (1978, p.201).

The study of the modeling process in widely different semiotic systems of culture identified the theoretical-analytical practice of cultural semiotics. Yuri Lotman (1977)¹⁰ found that the growth and diversification of the media, as the other sign systems of culture, perform different semiosis, since modeling takes place in a technological level that formulates languages from processes that are distinct from those that generate human verbal language. And this is the case with graphic language that makes use of different cultural forms in order to create language.

¹⁰ LOTMAN, J. *The Structure of the Artistic Text*. Translated by Gail Lenhoff and Ronald Vroon. Ann Arbor, MI: University of Michigan, 1977. [Michigan Slavic Contributions; 7]

Since the first edition of *Pesquisa FAPESP*, graphic language has been shaped by the treatment of the textuality of its contents: branding, cover, table of contents, layout, and graphic design. To create the graphic language of news and scientific reports, the journal did not hesitate to incorporate the various types of semiotic forms in its writing system. The graphical experience of the printed book and the newspaper has become fundamental and coexists with innovations, such as we observe in the presentation of the table of contents (Fig.2).

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Fig.2 – Table of contents. *Pesquisa FAPESP*, n. 47, Oct. 1999, p.3.

With the insertion a graphic composition as a synthesis of the enunciated paper, the table of contents works at two enunciative levels: the verbal proposition of the title, written with discrete signs, and the graphic-visual synthesis produced by continuous signs.¹¹ Each level mobilizes a kind of perceptual and cognitive activity. Whereas the phrase is guided by the analysis, the visual framework is in charge of building

¹¹ It is worth stressing out that discrete signs are those susceptible to decomposition, such as letters and sounds, and continuous signs are those presented in the contiguity and unity of their constitution.

comparative syntheses, i.e., syntheses realized from the insertion of known elements, made familiar by the media, from which it is possible to establish comparisons and draw inferences. Analysis, synthesis and inferences are elementary processes of reasoning and guide the search for knowledge through operations of inductions, deductions and abductions, as understood by Charles S. Peirce (1980, p.43).

Thanks to the relational reasoning that presides over the composition of the graphical argument, we can examine the integration of the report with the illustration, which constitutes the graphical argument. In the article regarding the research on the neurophysiological impact of violence (Fig.3), in the center of the pages, we find the paintings of Gustav Klimt and Eduard Munch as a visual syntheses of psychic disorders modeled in a film frame by the graphic work – taken here as the yardstick. Thus, besides stating the content, the paintings dialogue with fundamental concepts and perform the editing operation on the graphical plane.



Fig.3 – O impacto do horror [The Impact of Horror]. *Pesquisa FAPESP*, n. 117, Nov. 2005, pp.48-49.

The modeling process of graphic language also makes use of technological instruments, such as cameras, satellites, microscopes, mirrors, videos or software to meet conceptual (and not merely illustrative) purposes, such as the following images: a

photograph of the drought in regions of Brazil (Fig.4) and the graphic computer design about the interference of light during sleep (Fig.5).

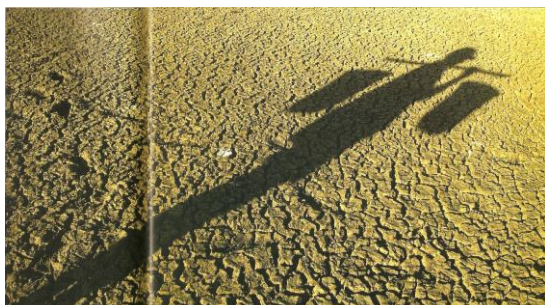


Fig.4 – Flancos vulneráveis [Vulnerable Flanks]. *Pesquisa FAPESP*, nº 121, Mar. 2006, pp.25-6.

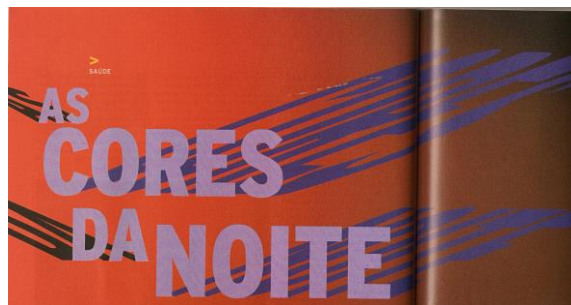


Fig.5 – As cores da noite [The Colors of the Night]. *Pesquisa FAPESP*, nº 166, Dec. 2009, pp.21-2.

The articles were produced in different years and with different semiotic systems: photography and graphic design. However, the argumentative graphic resource is constituted of a repertoire of common graphic forms that are laid out by projecting shadows at an oblique angle. In the photograph, the angle of the shadows combines the topics of the subject field regarding the drought.¹² The longitudinal shadow cast on the dry soil reveals how the drought crosses the landscape. In the graphic design, the angle of the shadows confronts the topics of physical health, associating colors, light with sleep. Both the picture and the computer graphic design have become the forms of a visual alphabet in the print medium that graphic language modelizes in the scientific text. Repeated in several articles, they become trainers of reading visual forms.

Moreover, it is from the angle of the takes that one can get in touch with the images produced by microscopes or camera lenses on satellites in maps and diagrams over large territorial extensions.

In the issue of May 2010, the cover of the journal follows the study on climate change based on the floods that affected an entire district of Sao Paulo. To report the drama of the flood, the article starts with the photograph of the flooded region (cover photo), the stranded people, and the runoff of land in slope regions. Based on the information on the conditions of soil drainage in urban areas, a diagram of the weather conditions of the city is drawn. It can be seen in the image taken by satellite (Fig.6) in

¹² TN. Droughts usually occur in the Northeast of Brazil.

which scientists state their inferences and present their weather forecasts. How can we ignore the graphic movement of this line of thought that is translated graphically?



Fig.6 – Para evitar novos flagelos [Avoiding New Scourges]. *Pesquisa FAPESP*, n. 171, May 2010, pp.14-21.¹³

The enhancement of the use of photographic devices prompts a compositional diversity of the line of reasoning in a complementary graphic activity. Suppose the graphic composition of the page submits completely to the modeling of magnifying lenses, even if only to visualize a fragment. The so elaborate graphic compositions question the notion of space, its representation, and especially its communication when they enlarge or reduce the elements of experience, requiring different elaborations of reasoning. To do so, it is necessary to develop specific cognitive skills.

Let us note that the reasoning employed to read the photographic image cannot be upheld when it comes to reading the satellite image or the magnified image by the microscopic lenses that bring to the visible plane that which is not of the order of visibility. A camera movement as processed in the audiovisual filmic composition reverberates in reasoning in the comparative exercise. Not only the microscopic images but also the digital ones of the minimalist world and nanotechnology are now modeled in graphic space. This is the case of the composition that provides the image of the genome included in the study on the genetic variability of the protozoan *Trypanosoma*

¹³ A look at the Metropolitan area – purple: sealed area in 2001; green: expanded area in 2008; yellow: projection of urban area in 2030.

cruzi, the parasite that causes Chagas disease (American trypanosomiasis) and whose sensory effect cannot be ignored (Fig.7).



Fig.7 – Fascínio e terror. [Fascination and Horror]. *Pesquisa FAPESP*, nº 114, August 2005, pp.42-45.

Although the aesthetic effect predominates, the page composition with amplified resources from computer graphics also modelizes the main elements of genomic composition of the parasite: the complexity and repeatability of genes and chromosomes that make it impossible to give the genome the form of a long tape, which, in the opinion of the researchers, is translated as fascinating (FIORAVANTI, 2005, pp.44-5). Thus, landscapes are created. Their aesthetic effect, derived from the plastic modeling of the researched object itself, resets the notion of space, operating combinations and overlays to stimulate interpretants (in semiotic sense) by means of comparative and associative relations.

The graphic landscapes developed over *Pesquisa FAPESP*'s editorial lifespan consolidate graphic language from the point of view of a repertoire of forms as well as from the investigation of analytical syntheses placing the research topics in their natural, biological, historical, technological, socio-cultural, and artistic environments. Not just modeling, but also feedback shows how the discursive forms of iconic languages multiply and change ways of thinking through complementary exercise. Many of the

aspects of iconic language join the argumentative graphic composition by means of feedback, a procedure to exploit the prosification of culture in times of mass media. Canonical icons, conceptual metaphors and logical snapshots play this role.

3 The Iconic Character of Arguments

In the general theory of signs, the icon corresponds to the class of signs that signify the relation of similarity between the sign and its object. Due to its properties, the icon qualifies its object and projects its possibilities. But the icon is also the class of signs that define the act of thinking in its reasoning, since every reasoning fulfills a developmental pathway that takes place in a figure or a diagram. According to Décio Pignatari:

Now, reasoning has to make its conclusion manifest. Therefore, it should primarily be concerned with forms, which are the main objects of rational insight. It follows that icons are especially required for reasoning. A diagram is, first of all, an icon – and one of intelligible relations (1974, p.43; our translation).¹⁴

Once the icon gives shape and defines the means of articulation of thought, the conception of “iconic thought” would almost be a redundancy. Nevertheless, when the icon is detached of its capacity of formulating synthesis, its usage is justified. Therefore, to the icon it is attributed the possibility of discovery since it reveals properties of the object constitution, which makes it an engendering base of the graphic argument.

Even though we understand graphical argumentation as a form of thinking that, in language, takes a diagrammatic configuration, not only is visuality the tonic of graphic argument, but it is also the relational character of the semiotic unfoldings of signs of different configurations. The argument in its graphic expression results directly from the metalanguage that builds it more as a hybrid of words, numbers and figures than as a single visual piece. In other words, the graphic argument synthesizes the possibilities of thought articulation in semiotically-expressed reasoning. And these are

¹⁴ Text in original: “Ora, o raciocinar tem de tornar manifesta a sua conclusão. Por conseguinte, deve ele ocupar-se principalmente de formas, que são os principais objetos da intuição (*insight*) racional. Segue-se que os ícones são especialmente exigidos para o raciocinar. Um diagrama é, antes de mais nada, um ícone – e um ícone de relações inteligíveis.”

the fundamental constituents of conceptual composition in science. We can quote Jay Lemke's (1998, p.87; emphasis in original) formulation here, according to whom

The “concepts” of science are not solely verbal concepts, though they have verbal components. They are semiotic *hybrids*, simultaneously and essentially verbal, mathematical, visual-graphical, and actional-operational. The actional, conversational, and written textual genres of science are historically and presently, fundamentally and irreducibly, *multimedia genres*.

The very meaning of what we understand by “graphic” is the result of an operation of iconic semiosis. Firstly, it is a conventionalized conceptual transformation. Features of a graphic coding result from discrete geometric elaborations (shapes, lines, points) transformed into continuous signs. The continuous graphic dimension, however, does not erase discrete signs from their constitution.

The following text (Fig.8) may be examined as an exemplary construction of the iconic principle governing both the language and the translation of the thought here expressed in conceptual form. It explores some aspects of graphical argumentation that will be examined along the essay: the synthesis of the proposition; the arrangement of forms of reasoning; dialogic-discursive principles; the modeling of graphic language; figurative plasticity; interaction diagrams, and especially the synthesis designed by graphic production.

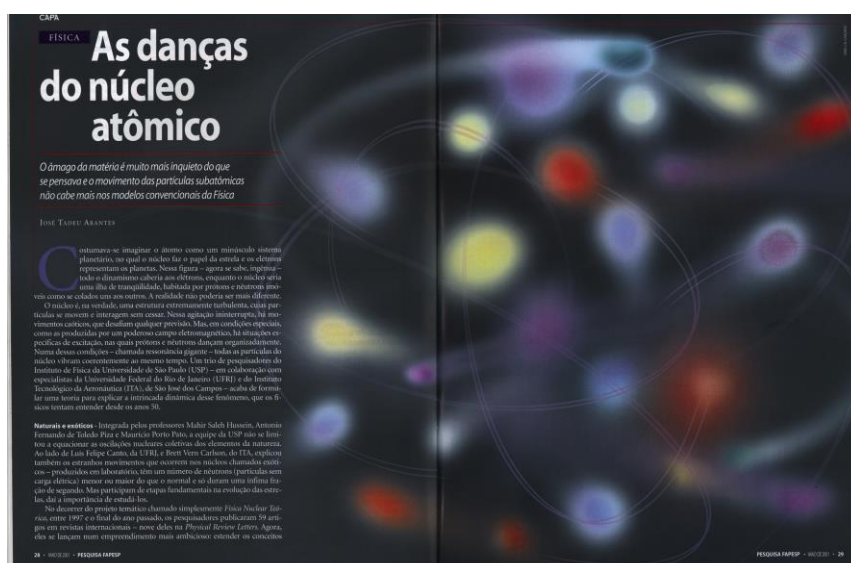


Fig.8 – As danças do núcleo atômico. [The Dances of the Atomic Nucleus]. *Pesquisa FAPESP*, nº 64, May 2001, pp.28-29.

“The dances of the atomic nucleus” (*Pesquisa FAPESP*, no. 64, pp.28-35) presents the research on the nucleus of the atom conducted by Brazilian physicists. It challenges existing models and proclaims the nucleus as an “extremely turbulent structure whose particles move and interact ceaselessly. In this uninterrupted restless activity there are chaotic movements that challenge any forecast” (ARANTES, 2001, p.28).¹⁵

The graphic argument is not limited to verbal enunciation but reverberates in the composition of the whole page translating the conceptual context: a dark-surfaced graphical environment, almost a film negative, with trails of lights and movement, as it constitutes up until that moment the understanding of the trajectory inside the nucleus. There is also the widening effect giving visibility to the elements taken as invisible. That is the nucleus’s turbulent and unpredictable environment, the departure point of argument analysis, which is similar to the *topoi* of *inventio* (in Rhetoric). The inaccuracy of the space of graphic composition demonstrates the scientific premise in focus, since the nonlinear outflow is understood as turbulence, such as the physics of particles, fluids and movement has studied.

From the semiotic point of view, the page thus constructed creates an exploratory environment of kinetic and visual sensations through which we expect to constitute the dance of the nucleus. It is defined, therefore, as the experience of reasoning in touch with sensations, which Ch. S. Peirce’s semiotics (1980, p.17) understands as firstness, the action of generality that is fundamental to the formulation of arguments. It is sensations that are open to the web of inductive inferences; after all, what graphic design tries to conceptualize is the movement and turbulence believed to define the character of the nucleus while characterizing space. The dance occurring in it translates the scope of possibilities and hypotheses of its composition. Hence, it can be said that the graphic argument builds another conception of nucleus which is the object of study in the research on this topic.

The graphic argument becomes part of the reasoning at the moment of its engendering. It does not differ from the exposure developed in the verbal plane. In this sense, the turbulence of the nucleus is the expression of this negative image that computer graphics allows.

¹⁵ Text in original: “estrutura extremamente turbulenta, cujas partículas se movem e interagem sem cessar. Nessa agitação ininterrupta, há movimentos caóticos, que desafiam qualquer previsão.”

The notion of iconic thinking imposes itself with the privileged place of argumentative construction since it is the relations observed in the experience that take control of representation (*inventio*). When we report to *inventio*, we do not recover the formulas of an established repertoire, but the strategy of thinking the space of representation as fundamental for the construction of the argument. In this place (*topoi*) the graphic construction is designed, and the very object of observation is projected as a visible body. This is the role of diagrams such as infographics (Fig.9), which make up a significant sphere of the graphic language of metalanguage in science.

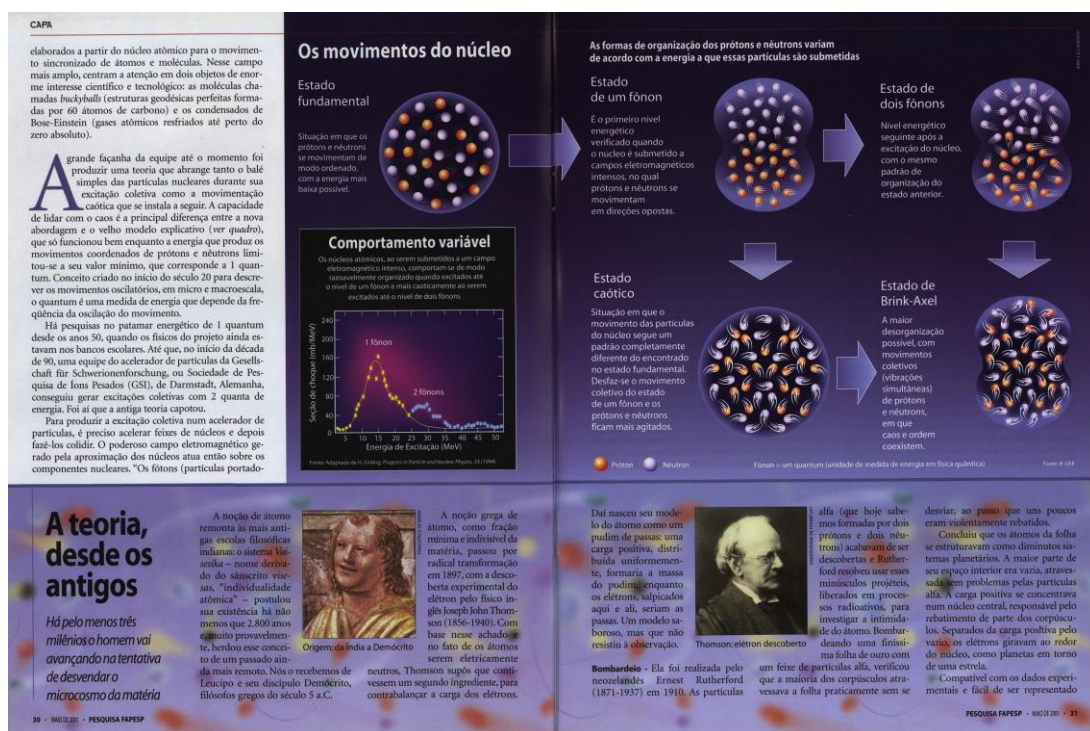


Fig.9 – As danças do núcleo atômico. [The Dances of the Atomic Nucleus]. *Pesquisa FAPESP*, nº 64, May 2001, pp.30-31.

Reasoning assumes here an iconic character since its development is translated graphically on the infographic, which forwards the analysis not based on results, but on the interpretation and comparative analysis of the processes. It operates, therefore, as the effects constructed by means of procedures manifested by conceptual metaphors, canonical icons and logical snapshots, as we will examine next.

Conceptual metaphors. From a theoretical point of view, metaphorical knowledge does not follow the logical concepts that take form from syllogism and its

generic premises that are deducible from each other. Metaphor operates by relations of similarity and does not call for syllogism, but for speculative imagination. Metaphor drives an analogic operation of reasoning working by associations, comparisons, and inferences. Acting near relational fields, metaphor keeps distance from the universe of concept. We would be facing an epistemological dilemma if metaphor were not characterized as having the ability to operate generalities and synthesis when promoting approaches. In this sense, it is through the bias of generality that metaphor comes into the composition of concepts in the theory of language and is present even in those utterances that are under the sign of the rigor of postulates.

In the process of understanding semiosis, metaphors take the place of formulations that turn to the speculative side of concepts and offer them through analogies. It is also through metaphors that conceptual environments, such as those expressed in the article about the dance of the nucleus, are developed. Lastly, it is through metaphor that sensory thinking is exploited in order to value the role of analogies rising from the relations of similarity among qualities.

Conceptual metaphors are discursive constructions of great constructive power in the graphic arguments of the *Pesquisa FAPESP* journal, such as the one reproduced below (Fig.10). In it, the visual composition approaches the concept of the brain to the notion of a black box, of a mysterious file of records.



Fig.10 – O cérebro em ação. [Brain in Action]. *Pesquisa FAPESP*, nº 98, April 2004, pp.45-48.

Undoubtedly, the idea of the brain as a black box does not fail to constitute an expressive icon of graphic composition. The article deals with the ongoing research of professor Miguel Nicolelis on the control of robots and prostheses by means of electrical signals of neurons. According to the report, some experiments conducted with Parkinson's disease carriers served as experiment for the understanding of electrical brain activity, paving the way to improve the miniaturization process of the microelectrodes required for interference in these areas of the brain. Instead of visible wires and electrodes, the demand is for thin edges, as the graphics show.

Conceptual metaphors oblige graphic arguments to operate with relational traits with varying degrees of analogy. Aware of such variations in the activity of iconic thought, Peirce (1975, pp.115-134) called hypoicons the icons whose resemblance to the object is relative, almost a suggestion, since *hypo* designates low valence of an element or a functioning. Metaphors as well as diagrams belong to this sphere. In this sense, conceptual metaphors that express reasoning through analogies do not apply only to formulations that bring world events closer to experience but they also welcome the probabilities.

Canonical icons. The controversial paleontologist-evolutionist Stephen Jay Gould went far in his analyses of the language of science from the point of view of theory elaboration. He noticed that the need to semiotize concepts in science introduced what he called "canonical icons," offering knowledge through conceptual keys of graphic-visual character disseminating no less important interpretations.

According to the paleontologist, canonical icons are fundamental for the dissemination of concepts although they are often reformulated, such as the icon of the progression from simian to man, which contributed to spreading the idea of evolution.

Gould (1997, p.38) considers canonical icons as "standard images linked to key concepts of our social and intellectual life"¹⁶ and constructions of every great theory. The language of science is not built only with precision procedures, but with conflicting interpretations. To what Gould adds:

Icons are at the center of our thoughts and not on the margin; thus, the problem of alternative representation becomes fundamental to the

¹⁶ Text in Portuguese: "imagens-padrão ligadas a conceitos-chave de nossa vida social e intelectual."

history of transformation of ideas into science [and even for the quite legitimate notion of scientific progress] (1997, p.60).¹⁷

As they refer to operations concentrated in code formulations, canonical icons create interpretations that offer theory from other concepts. The expression “canonical” exposes the conventional character and the capacity to generate the sense of the sign thus agreed upon.

Gould’s lesson is precise: it is necessary to consider the alternatives of representation that may be vigorous not only for the constructive dynamics of the theory language, but also for the ulterior life of science. It is through the complementarity between figures and words that an essential dialogue for the architectural composition of the arguments at issue is established.

The model of the DNA double helix developed by James D. Watson and Francis Crick is another canonical icon that competes with the diagram of evolution. In the article concerning the research that proposes, still experimentally, the link between diet and genes in order to control the tendency of organisms to develop diseases such as diabetes, the graphic builds the notion of nutrigenomics through the icon that, in a way, is already placed as a possibility, even though the researchers insist on the impossibility of an immediate application in the short term (Fig.11).

¹⁷ Text in Portuguese: “Os ícones estão no centro de nosso pensamento e não na margem; por isso, o problema da representação alternativa torna-se fundamental para a história da transformação das idéias em ciência [e mesmo para a noção bastante legítima do progresso científico].”



Fig.11 – Saúde à mesa. [Health at the Table]. *Pesquisa FAPESP*, nº 175, September 2010, p.64.

If canonical icons move relations capable of promoting conventions, the “logical snapshots” stimulate the syntheses of thoughts. Introduced by Bas C. van Fraassen (2007, p.122) in his study of the scientific image based on classical rhetoric, the notion of “logical snapshot” was forged from the act represented by the photographic snapshot, when the diaphragm’s fast opening exposes the film to the light. At that moment, two different phenomena occur, mutually implicate and transform each other: the amount of light that can pass through the aperture produces a visual record and both generate the photographic image, understood broadly as the quality of light in the process of transformation.

By turning it into a philosophical concept, the term “logical snapshot” reaches the synthesis of the dialectic process of transformation of the amount of light into semiotic quality and prints dialogy onto the semantic load of the term, expanding its capacity to qualify a process. The predicate “logical” in place of “photographic” implies

a set of relations of another nature. In the context of Fraassen’s philosophy of language, “snapshot” is a valuable term, capable of relativizing the logical accuracy and introducing in it the ephemeral and the change, as in the photograph. “Logical snapshots” refer thus to constructions of effects of senses that are dynamic and susceptible to change and to interpretations according to the context; effects that result from processes in transformation, the becoming modified by instants.

To examine the logical snapshot as the constructive procedure of language in the communication of science, it follows the compositional work in which the graphic argument transforms everyday concerns in ways of thinking, such as the montage accompanying the essay “Those who do not know how to dance improvise” published in *Pesquisa FAPESP* journal in 2007 (Fig.12). The essay is about a thesis on hip-hop, the artistic manifestation on the outskirts of the city of Sao Paulo. The thesis does not take hip-hop as a representative of violence or as its actor, but as an artistic proposal for political participation through the disagreement that everyone can exercise critically, even if through the bias of improvisation. The article refers not only to the academic work that yielded data on the movement in Sao Paulo, but also confronts positions and assumptions of the movement in Brazil and the USA.



Fig.12 – Quem não sabe dançar, improvisa. [Those who do Not Know How to Dance Improvise] *Pesquisa FAPESP*, nº 142, December 2007, p.80.

The report shares the graphic space with the graphic-visual essay in dialogue with the academic formulations. A gallery of images refers to the universe of graffiti in the urban environment, of dances and also of *capoeira*, which in Brazil relates to the collective cry of bodies in struggle and contention in the public space (Fig.13).

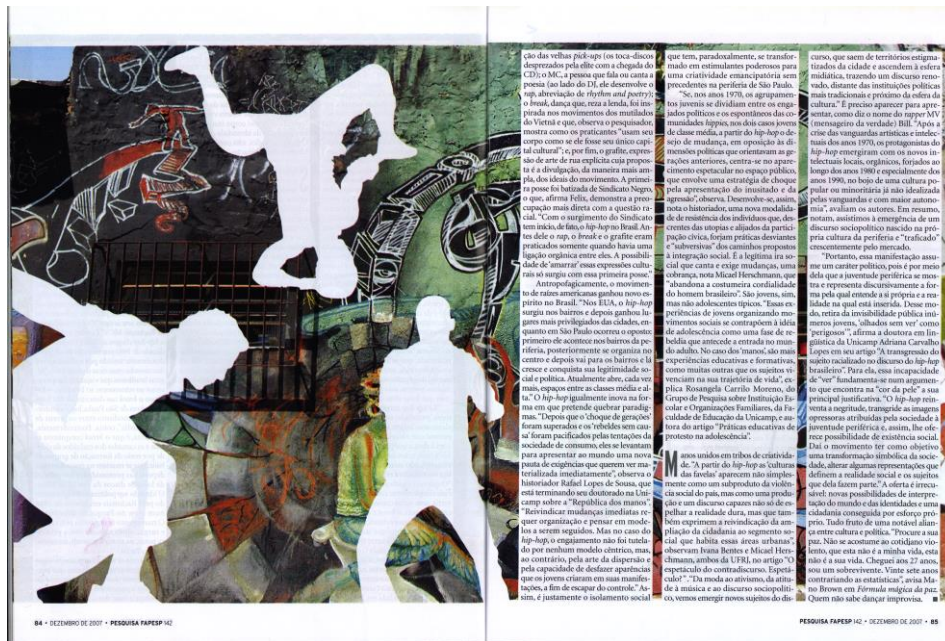


Fig.13 – Quem não sabe dançar, improvisa. [Those who do Not Know How to Dance Improvise]. *Pesquisa FAPESP*, nº 142, December 2007, p.82.

The plastic set of human figures in white and the text of the report in the column white – both overlaying the colorful montage of images of urban graffiti – suggest the logical snapshot in the movement of its composition.

Conceptual metaphors, canonical icons, logical snapshots compose the architecture of argumentation that analyzes effects and projects them under graphical form – as an interpretive possibility. Here the cognitive and epistemological world is guided by probabilities, sensory and environmental conjugations in which nothing is isolated. The concern to present processes without describing the final stages is perhaps the most explicit representation of the means seized as moving objects.

We see the birth of an epistemological perspective that develops another way of formulating the language of science, coherent, however, with its object – the means of communication or the environment that transforms quantities into qualities. This is a diagrammatic mode of thinking in the semiotic sense of the term: diagram as the

configuration of structural process of knowledge oriented by patterns. In this case, the criterion of the scientificity of the investigation cannot be designed based on postulates and axioms.

Final Considerations

From the results brought by analyzing the *Pesquisa FAPESP* journal, we would state that such journal was installed in the public space of science communication with a strong awareness of media attuned to the purposes of graphic language in printed media. The combination of different media dignified the journal as the source-object of reference for the study of communicating science in what it most specifically develops: the transformation of experiment and scientific information into text of communication. To do so, the editorial project has teamed up with a graphic project committed to building textuality doubly modeled by the graphic resources of the printed media and also by the tools of science itself. That is, graphic-visual textuality does not hesitate to modelize the visuality of lenses and screens that are now indispensable to scientific research. In this case, the journal presents strong arguments to the hypothesis that the textualization of science in a journal may put away the vulgarization understood as simplification. Because it deals with a diversity of languages (codes and signs of each area of knowledge), it transforms the multiplying process of semiosis into interpretants. Thus, the understanding of sense is produced by different areas of semiotic expression.

In this sense, the *Pesquisa FAPESP* journal embodied the discursive formation that offers scientific prose as essay, which, in the context of the process of culture prosification, means interaction with the means and processes developed in the public space of the wider social communication, turned consequently into the condition of its development, from the point of view of publication and comprehension. Recognizing itself as a public space implies opening a dialogue with society (which exceeds the scientific community) and, therefore, seeking formulas of discursive interaction in different spheres. In both cases, it is about operating with the textualization of scientific information. Only in the play of these articulations may we conceive of the establishment of interpretants that are not necessarily individuals.

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Translated by Fernando Antonio dos Santos Sobral Junior –
fernando@fernandosobral.com

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