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Review Article

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# Graphic Communication of Scientific Research

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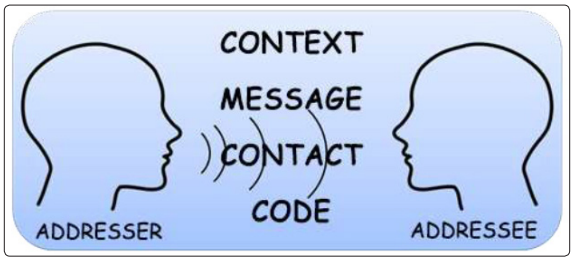
***Abstract***

*Scientific communication is going through a new era, thus researchers have to revalue communication importance: not only divulgation, due to its social impact and implications, but even communication between scientists. Graphics is a language able to increase attention, understanding and memorization. It engage people to overcome noises of other communications. To know and to handle graphic language rules allows a higher quality communication.*

**Keywords:** Graphics Communication, Scientific Communication, Graphics in Scientific Research, Scientific Research Communication

## Communication of Scientific Research

Have you ever asked yourself what communication is? The most famous definition was given by Roman Jacobson in 1960: "the ADDRESSER sends a MESSAGE to the ADRESSEE. To be operative the message requires a CONTEXT referred to (...) seizable by the addressee, and either verbal or capable of being verbalized: a CODE fully, or at least, partially, common to the addressee (...) and, finally, a CONTACT, a physical channel an psychological connection between the addresser and the addressee, enabling both of them to enter and stay in communication" (Figure 1) [1].




From this point of view, communication of scientific research is characterized by a scientist-like addresser and a scientific research topic as message. But what about the addressee? Science communication includes public communication of science related topic to non-experts but even communication among scientists [2]. The last one isn't restricted to national or international meetings; all scientists communicate about science by everyday speaking with colleagues, bosses, students, customers or even by reading a paper or writing a poster. Difficulties typify each situation: we can encounter some communication noise, like hearing problems, complicated acronyms memorization, language troubles or difficulty in concentration. Graphic language is a resource to elevate and enhance the message efficacy, especially in cooperation with verbal or writing communication, because redundancy easily helps us to overcome many noises of other kind of communications. Redundancy concept was introduced by Shannon in the "communication theory" in 1945 [3]. It is a message property: we have redundancy when the number of signals is higher than needed. Redundancy can be intentionally used to help the addressee comprehension, especially when the addresser wants to prevent misunderstanding by corrective elements. Sometimes it could be indispensable.

## Graphic Communication

Starting from Jacobson definition, we have a graphic communication when communication is made by a graphic code. Indeed, graphic is a language: made by images (photos and illustrations) but even by shapes, colors, space [4]. As well as any other kind of language, Graphics is characterized by rules. The definition of those rules was the research subject of the Graz psychology school and Gestalt theories. In the last century, Professor Kanizsa (1913-1993) developed and summarized them all [5]. Beside the visual interpretation, there is also color psychology, born in 1810 with Gothe [4]. After many years of pure physical and mathematical approach, the "Theory of Colours" proposed a cultural influence in colors perception [6]. To know and to handle graphic language rules represent a great advantage for scientific research communication. Let's think how statistical graphs are powerful ways to transparently and succinctly communicate the key points of medical research. In the last century, even the biomedical research fields moved to smaller and smaller study environments, such as nanotechnologies, for example. New models capable to visualize invisible data and mechanisms became more and more important for the worldwide dialogue. As well as any other kind of communication, Graphics can be disturbed by communication noises: the main ones are the perception difficulties, just like readability of a text or of an illustration on textured backgrounds [7]. But it could be very useful to overcome the noises of other communications: thanks to redundancy.

## Why graphics?

Graphics increase attention, understanding, memorization and ability to make decision; it engage people into physical and emotional challenges [8,9]. This is why it is very useful also for scientists to

know graphic language, especially for those who have to explain non-visible mechanisms or methods. Graphic language allows a quicker communication compared to the same message sent without the visible code support: we can get the meaning of a visual scene in less than 13 millisecond while we need 150ms for a symbol to be processed + 100ms to attach a meaning to it, which is what happens with words. Visualization increase memorization: people recall 80% of what they see and do, 20% of what they read and 10% of what they hear [10-13]. Graphic language increase engagement and it is easily accessible: people following directions with text and illustrations do 323% better than people following directions without illustrations [14]. Visual representation is universal: very useful for international contexts, like research fields and labs, or contexts in which different cultures, scientific areas of interest and points of view are mixed together. By helping your audience to imagine and elaborate your theories, you enhance your activity with their knowledge and ideas. Scientists already rely on diagrams, graphs, tables, videos, photographs, and other images to present discoveries, explain findings, and excite public interest [15]. Ainsworth et al, in 2011 on the journal Science, discussed drawing efficacy to enhance engagement, to learn to represent in science, to reason in science, to learn strategy and to communicate [1].

## When?

Visual presentations can be very functional to create redundancy: it reinforces words. It's the key to face communication noise and to reduce the probability of misunderstanding [16]. Graphic Communication is useful to describe something that is invisible, just like a molecular process, to show spatial orientation and relations or illustrate timing modifications [17]. It summarize big data, giving us an overview and helping relations identification. Graphics could increase story telling communication technique efficacy: a good example of graphic narrative was described by Melinda Krakow in 2016 [18]. Communication occasions for Scientific Research are national and international meetings but also speaking with colleagues; the channels can be papers (such as posters, publications, applications) or monitors (just like congress presentations or during lab meetings). All this situations allow us to use graphic communication together with all the other kind of communications.

## Graphic tools

Making visualizations is already integral to scientific thinking, indeed scientists imagine new relations, test ideas, and elaborate knowledge through visual representations [2]. The choice of the optimal graph type for a given dataset plays a key role in our communication of scientific research; many interesting suggestions were published in 2015 by Duke et al. [19]. They provide a mechanism for selecting the appropriate graph to thoughtfully construct quality deliverables using good graphic design principles. Indeed, the same data can be presented by different graph type based on what do you want to come to light (Figure 2). Recently, new instruments were used and tested just like infographic (4): an innovative and engaging method of visually communicating information in a colorful and concise manner. McCrorie et al. describe five different types of infographics and demonstrate how they may be used to communicate a variety of healthcare information: isotype array, polar diagram, word cloud, hub and spoke diagrams and charticles [8]. An isotype array represents increasing quantity as multiple identically sized graphics. A polar area diagram is a pie chart combined with some of the features of a stacked bar chart. A word cloud is a method of visualizing text in a colorful and eye catching manner.

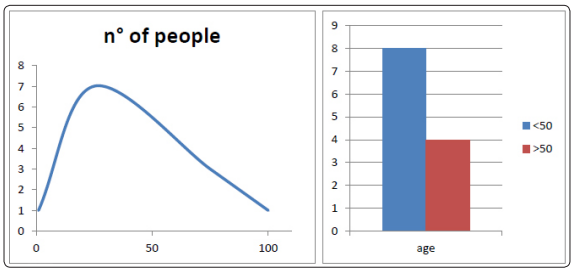



**Figure 2:** Two different graphs to give the same dataset: ages of people tested. On the left to show sample distribution; on the right to highlight groups' proportion.

Hub and spoke diagrams are featured by a central 'hub' surrounded by branching 'spokes' that connects the central topic to a number of peripheral topics. A charticle contains a combination of attractive colors, easily understood text, and key graphs or charts that aid in the delivery of a central message [8]. Infographic can be very useful for a visual abstract, more and more requested nowadays because it is perfect to convey complex information [20]. A new communication technique is torytelling, and also scientific storytelling start catching on. Storytelling is based on recent studies which indicate that people are neurologically prone to focus on content with story structure. Scientific storytelling is the process of recognizing the story elements already present in the subject material and distilling the most concise and compelling for a target audience [21]. Some channels allow us to use movement, which is very helpful to engage attention [22]. New technologies allow us more interactivity to conquest new dimensions of involvement: 3D modeling and animations, gamification and virtual reality for example. Alsaid compares two anatomy-teaching tools: graphics tablet and slideshow presentation. The author concluded that using a graphic tablet to draw when teaching anatomy is applicable, feasible and effective. It is the opinion of the author of this paper that use and draw with a graphic tablet could help not only anatomy teaching but even any other spatial language communication. Visual attention during spatial language comprehension is extensively studied by Burigo et al. at 2015 [17,23].

## Conclusions

Graphic communication of scientific research is a new field for scientists. Graphics is a very old language, even older than writing, and widely spread but it often used without consciousness or academic bases. In this new era for communication, researchers revalue also communication between scientists because science research needs links, contacts and networking. Nowadays, new technologies allow us a bigger worldwide dialogue: it means having many opportunities but also increasing competition and difficulties to focus on important information. Visual communication is actually the main mean of communication and to know and to handle graphic language rules allow a higher quality communication. Graphics is an old language but only a few researchers studied graphic rules by applying the modern scientific methods and this research field would be a great opportunity for investigation.

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## Disclosure of interest

The author declares that he has no competing interest.

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