Icons of Complexity

Attilio Baghino

Laboratorio AnimazioneDesign, DADU, Università di Sassari, Italy

attiliobaghino@architettura-uniss.it

Abstract. In many areas of communication, it is easy to use a pictogram to express a concept. This is more difficult when communicating complexity, an area in which only concepts such as feedback, homeostasis, redundancy, can be efficiently and concisely expressed only verbally. This paper documents the early stage of an attempt to use individual pictograms to express some complex concepts - just as we use individual words to express those concepts.

Keywords: Icons / Complexity / Feedback / Homeostasis

1 Introduction

Is a picture really worth 1,000 words? This could possibly be true in many fields, but not when communicating complexity. Nowadays, concepts such as feedback, homeostasis, redundancy, can be efficiently and concisely expressed only verbally, since there is no iconic and simple graphic equivalent. Most of the times their representation reproduces an "exploded view" of the elements involved, even though such a slavish schematization is not always required.

This paper documents the early stage of an attempt to use individual pictograms to express some complex concepts - just as we use individual words to express those concepts.

2 From pictograms to writing

The Western cultural tradition sees the history of writing as a linear process that starts with orality, goes through the pictorial representation of objects, then on to the use of conventional characters that transcribe words and phrases, to finally get to alphabetic writing.

In Plato's *Phaedrus*, Socrates tells Phaedrus about the Egyptian god Theuth: «To him (to pharaoh Thamus) came Theuth to show his inventions and Thamus asked what use there was in each (...). When they came to the letters, “This invention, O king,” said Theuth, “will make the Egyptians wiser and will improve their memories; for it is an elixir of memory and wisdom that I have discovered.” » [1]

Even though Plato questions this thesis, tradition will adopt it fully, as can be seen in the following quotes, the first from the collection "Essays on Life, Art and Science" by English novelist Samuel Butler, the second by Edward Burnett Tylor, first professor of anthropology at the University of Oxford:

« The spoken symbol is formed by means of various organs in or about the mouth, appeals to the ear, not the eye, perishes instantly without material trace, and if it lives at all does so only in the minds of those who heard it. The range of its action is no wider than that within which a voice can be heard; and every time a fresh impression is wanted the type must be set up anew. The written symbol extends infinitely, as regards time and space, the range within which one mind can communicate with another; it gives the writer's mind a life limited by the duration of ink, paper, and readers, as against that of his flesh and blood body. » [2]

« The invention of writing was the great movement by which mankind rose from barbarism to civilization. How vast its effect was, may be best measured by looking at the low condition of tribes still living without it, dependent on memory for their traditions and rules of life, and unable to amass knowledge as we do by keeping records of events, and storing up new observations for the use of future generations. » [3]

When Butler and Tylor talk about writing, they refer to the concept currently used in the Western world: alphabetic writing, which is supposed to be the only one to guarantee civilization. One hundred years before Butler and Tylor, Jean-Jacques Rousseau in his *Essai sur l'origine de langues* already differentiated three types of writing: pictorial representations, conventional signs and alphabetic writing.

« These three ways of writing correspond fairly precisely to three different states of which one can consider men assembled into nations. The depiction of objects suits savage peoples; signs of word and propositions, barbarian peoples, and the alphabet, civilized peoples.[1] » [4]

This classification is not a thing of the past. Visionary and pioneer sociologist Marshall McLuhan deemed this classification still very relevant in 1962 in his famous book *The Gutenberg Galaxy*, which has been a point of reference in the study of mass media for decades:

« Only the phonetic alphabet makes a break between eye and ear, between semantic meaning and visual code; and thus only phonetic writing has the power to translate man from the tribal to the civilized sphere, to give him an eye for an ear. The Chinese culture is considerably more refined and perceptive than the Western world has ever been. But the Chinese are tribal, people of the ear. » [5]

[1] «Ces trois manières d'écrire répondent assez exactement aux trois divers états sous lesquels on peut considérer les hommes rassemblés en nations. La peinture des objets convient aux peuples sauvages ; les signes des mots et des propositions, aux peuples barbares, et l'alphabet, aux peuples policés.»

3 From writing to pictograms

Yet the pictographic language was not detached from the Western cultural context. In the second half of the 1920's Otto Neurath was already at work in Vienna within the intellectual context of logical empiricism. Economist and philosopher, he was head of the economic section of the Ministry of Defense and founder of the Museum of Society and Economy. The museum had the explicit mission to educate adults and within this mission Neurath developed the “Vienna method of pictorial statistics" which included the development of ISOTYPE (International System of TYpographic Picture Education), a corpus of sophisticated pictograms - designed by Neurath and drawn by designer Gerd Arntz - which over the years grew to contain about 4,000 symbols.

« Turning the statements of science into pictures in frequently a delicate business, and it is not the work of a man of science or of a designer[2] Special attention to this process has given birth to the ISOTYPE system. Its rules are the instruments for putting together the work of science and the work of design[2]. » [6]

Otto Neurath, Gerd Arntz and ISOTYPE were the forerunners not only of scientific and statistical dissemination and therefore of modern information design, but also of the whole communicative context that includes public service signage systems and the graphical user interfaces for computers. [7] The "transformation" method theorized by Otto Neurath underlies all the stylization involved in the design of modern icons. Is it possible to think that after many years of cultural dominance by alphabetic writing, the current period brings a return to the pictographic language of the beginnings of human history? Is it some kind of revenge?

This revenge is in fact evident. Just think of the huge amount of pictographic signs that are part of our daily experience. Although a classification of icons and pictograms conducted with a scientific method is not available yet (as far as the writer can tell), cataloguing in broad terms by using some significant sources available [8, 9, 10, 11] leads to the following approximate families:

- signs (broadly speaking);
- interface with devices (and interaction design);
- emotional communication (with the many variations of the emoticons of typographic origin);
- representation of objects for cataloguing (ecommerce etc.);
- representation for “seductive” purposes (pictograms of a brand).

However, it is clear that the greatest creative effort is concentrated on the creation of different styles of icons and pictograms, rather than on creating new ones. For example, the same corpus of one hundred icons representing the office environment recurs several times with different designs, while it is very difficult

[2] The words "designer" and "design" were not used in the current sense, but rather to simply mean "person who draws" and "drawing". Even more so in this text which is not written in English but in Basic English. [TN]

to put together a stylistically consistent set to represents the classification of single cell organisms or the various types of investment funds, just to give a few examples.

In short, the ample dissemination of pictographic language has affected almost all areas of visual communication, but it has had little or no impact on the fields that actually started the phenomenon, namely education and the dissemination of ideas and of scientific, economic, sociological concepts and so on. The pictographic language is sometimes used to complicate what is already simple but it is rarely used to simplify what is complex!

4 Pictographic language and complexity

Albert Einstein is reported to have said: « Everything should be as simple as it can be, but not simpler. » [12] For several authors, complexity is what stands on the border between order and chaos. The map of the states of a complex system by Stuart Kauffman [13] and the map of the states of a cellular automaton by Christopher Langton [14] efficiently outline this concept. In the domains of order and chaos there is nothing to explain on the left side and on the right side: nothing yet on the left, nothing anymore on the right.

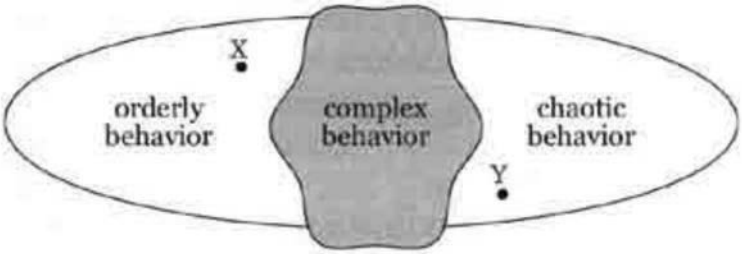


Fig. 1. Map of the states of a complex system according to the results of the study of Boolean networks (Kauffman).

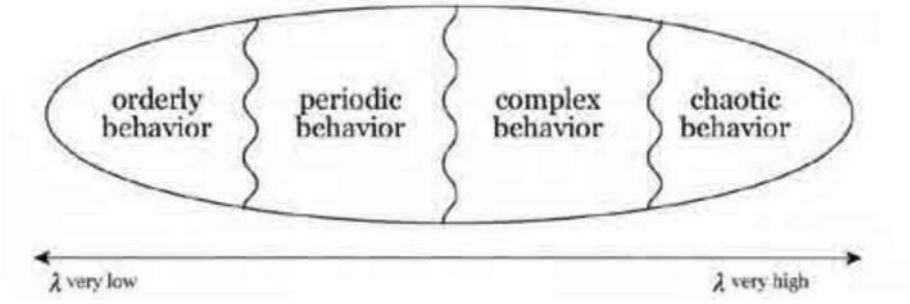


Fig. 2. Map of the states of a cellular automaton (Langton).

In the field of visual communication, these representations bring to mind “Chaos-Order”, the first chapter of one of Adrian Frutiger's most important books, “Symbols & Signs”:

« For Twentieth century humans it is difficult to imagine a void, a chaos, because they have learned that a kind of order appears to prevail in both the infinitely small and the infinitely large. The understanding that there is no element of chance around or in us, but that all things, both mind and matter, follow an ordered pattern, supports the argument that even the simplest blot or scribble cannot exist randomly and without meaning, but rather that it is the observer who does not clearly recognize the cause, the origin and the occasion of such a “design”. »[3] [15]

To better explain his thought, Frutiger uses pictograms to represent the concepts of chaos and order:

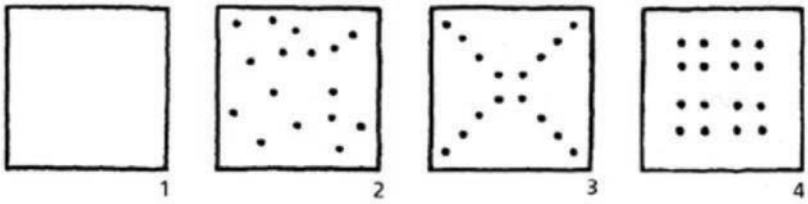


Fig. 3. Chaos-Order (Frutiger).

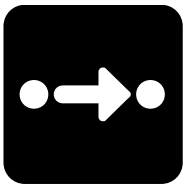
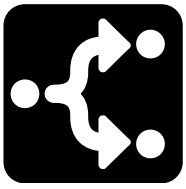
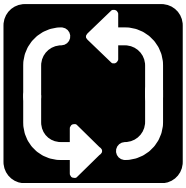
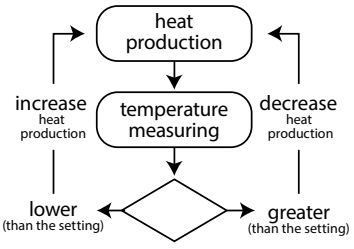
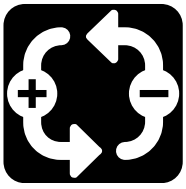
It is interesting to note that Frutiger's book does not deal with information design or the representation of complexity, but rather with the graphic history of signs. Frutiger deems it important to tell the story from the beginning, from the inherent human need to always assign a meaning to what one sees, therefore to create signs that can carry some meaning.

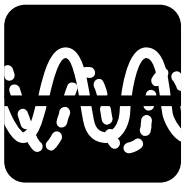
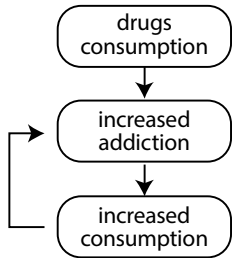
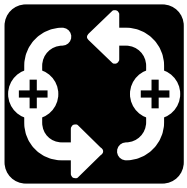
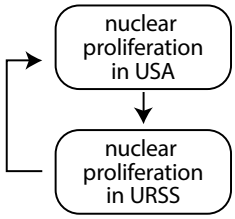
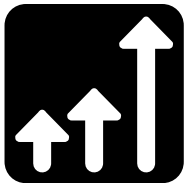
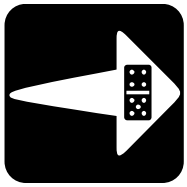
From this point of view, signs belong to the inherent human need to represent and communicate the meaning of things. Just as the concepts of complexity have advanced our understanding of reality by moving the border of what is understandable at the expense of the territory of chaos, the pictograms of information design, from Neurath's ISOTYPE to the present day, have moved the border towards a greater portrayal or "explicability" of reality.

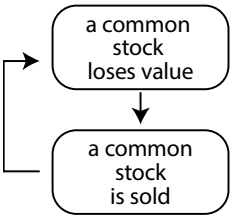
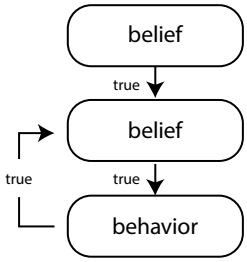
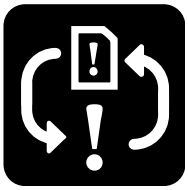
[3] «Für einen Menschen des 20. Jahrhunderts ist es schwierig, sich eine Leere, ein Chaos vorzustellen, denn er hat gelernt, daß im unendlich Kleinen wie auch im unendlich Großen eine Ordnung zu herrschen scheint. Die Tatsache des Begreifens, daß es um und in uns keine Zufälle gibt, sondern, daß die gesamte Materie (auch die geistige) einer geordneten Zusammensetzung folgt, unterstützt die Begründung, daß auch das naivste Gekleckste oder Gekritzel nicht unwesentlich, nicht rein zufällig sein kann, insofern der Betrachter die Ursachen, den Ursprung und die Veranlassung dieser »Aufzeichnung« nicht eindeutig erkennt.»

5 New icons to explain complexity

As anticipated at the end of Section 3, however, the "isotype-ization" (i.e. the design of pictograms that are useful for education purposes and for the dissemination of ideas and of scientific, economic, sociological concepts etc.), has come to a halt or it is slowly carrying on. Many pictograms are needed. In this section we offer some of them, specifically related to a few key words of complexity.

Linear interaction (sequential)	A component affects another component. Example: a star and a planet	$A \rightarrow B$	
Idem	A component affects another component, which affects a third component (and so on). Example: a star, a planet and a satellite.	$A \rightarrow B \rightarrow C$	
Linear interaction (Hub)	A component affects a second and a third component. Example: a transmitter and two receivers	$A \rightarrow B$ $\searrow$ C	
Feedback	A component affects another component. In turn, the second component affects the first.	A $\nwarrow\searrow$ B	
Negative feedback	A component affects /stimulates a second component, which inhibits/stops the first. The system levels off and finds a balance. Example: a heat control system		

Homeo-stasis	A component affects another component. In turn, the second component affects the first. The system levels off and finds a balance. Example: Lotka-Volterra predator–prey equations.	$\frac{dx}{dt} = x(\alpha - \beta y)$ $\frac{dy}{dt} = -y(\gamma - \delta x)$	
Positive Feedback	A component affects /stimulates another component. The second component further affects the first one. Example: the vicious circle of drug addiction.		
Escalation	A component affects /stimulates another component. The second component further affects the first one. The system grows really fast. Example: nuclear proliferation.		
Domino effect	A component affects another component, which affects a third component (and so on). The system grows really fast. Example: German reunification	**German reunification** – 19 August 1989: Hungary disabled physical border defenses – 18 October 1989: Erich Honecker resignation – 10 November 1989: Wall fall – 18 March 1990: East Germany election day – 1 July 1990: East Germany adopted West German currency – 3 October 1990: German reunification	

Snowball effect	A component affects another component, which affects a third component (and so on). The system grows really fast. Example: Stock Exchange		
Butterfly effect	Small perturbations can cause huge variations of a system. Example 1: meteorology. Example 2: Blaise Pascal and Cleopatra's Nose[4],		
Self-fulfilling prophecy	Prediction that causes itself to become true, due to positive feedback between belief and behavior. Example: the Oedipus myth (Karl Popper).		

[4] « Cleopatra's nose, had it been shorter, the whole face of the world would have been changed. » Blaise Pascal, *Pensées (180)*

References

1. Plato, *Phaedrus*, translated by Harold N. Fowler. Cambridge, MA, Harvard University Press; London, William Heinemann Ltd., 1925, section 274d-275b
2. Butler S., *Essays on Life, Art and Science*, R. A. Streatfield ed., London, Fifield, 1908, p. 198
3. Tylor E. B., *Anthropology*, Macmillan and Co., London, 1881, p. 179
4. Rousseau J.-J., *Essai sur l'origine des langues*, A. Belin, Paris, 1781, cap. 5
5. McLuhan M., *The Gutenberg Galaxy*, University of Toronto Press, Toronto, 1962, p. 38
6. Neurath O., *International Picture Language. The first rules of ISOTYPE*, Kegan Paul, Trench, Trubner & Co. Ltd, London, 1936, p.8
7. Jansen W., *Neurath, Arntz and ISOTYPE: The Legacy in Art, Design and Statistics*, in Journal of Design History Vol. 22 No. 3, Oxford University Press, 2009, p.227-242
8. Blackcoffee, *1000 Icons, Symbols + Pictograms*, Rockport Publisher Inc., Beverly Massachusetts, 2009
9. Abdullah R., Hübner G., *Pictogram Icons & Signs*, Thames & Hudson, New York, 2007
10. AA. VV., The Noun Project, http://thenounproject.com
11. AA. VV., Icon Archive, http://www.iconarchive.com
12. Zukofsky L., http://quoteinvestigator.com/2011/05/13/einstein-simple/#more-2363
13. Gandolfi A., *Formicai, imperi, cervelli*, Bollati Boringheri, Torino, 1999, p. 57
14. Ibidem, p.60
15. Frutiger A., *Der Mensch und seine Zeichen*, Heiderhoff-Verlag, Echzell, 1978-1981, p. 17