Visual Logic

Ranulph Glanville
CybernEthics Research,
52 Lawrence Road, Southsea,
Hants PO5 1NY, UK

Abstract

Four cybernetic activities (observing, designing, learning and conversing) are discussed in terms of one diagram. The diagram is interpreted so that the working of the four activities becomes clear. The similarities also become clear. In this manner, the diagram is can be understood as demonstrating the action of a visual logic, and some logical operations implicit in the diagram are expanded upon. Differences in the quality of the argument developed through visual and non-visual logic are presented. Backgrounds that differentiate ways of thinking including the visual—left/right brain studies, learning styles. the sense of the whole in spatial perception—are explored and the diagram and associated logical forms are related to these studies. The power of visual argument and its complementary relation to verbal and formal arguments is explored. This use of the term visual logic is contrasted with some other current uses.

Introduction

In a keynote I delivered to the Conference of the American Society for Cybernetics held in Washington DC in October 2005 [Glanville, R 2005b], I analysed four cybernetic activities. As I did this, I found that the diagram I drew for each was essentially the same. A little adjustment to the graphics, and they were identical, at least at one level, in all salient respects. I had wanted to show that these four activities were (in cybernetic terms) essentially homomorphic. I knew this intuitively, but I did not know how to show it convincingly: how to argue so the homomorphism between the four became transparently clear. Drawing the diagrams made the isomorphism apparent in a dramatic and unquestionable way, more than any other way I had tried. These diagrams form part of a visual logic. Many people have written about visual logic, often meaning something quite different. In this paper I shall examine aspects of the concept and place of visual logic and use the example from my Washington keynote to indicate some of the potential power waiting to be unleashed.

Von Bertalanffy, Warfield and visual logic

Recently, John Warfield [2005] wrote the following to the CybCom list (quoted with permission)

Imagine that, in choosing what graphic representation you will study, you decide to weigh heavily in your decision the capacity of the graphic representation to be subjected to fluid isomorphism treatment. By that I mean that, it can readily morph into a succession of formalisms. As an example, consider this succession:

0) Collection of formal English prose propositions, which morph into
1) Digraph, which morphs into
2) Boolean equations, which morph into
3) Boolean Matrix, which morphs into
4) Set theory representation, which morphs into
5) Computer code, which morphs into
6) Collection of formal English prose propositions

The stages in Warfield's cycle in turn brought to mind von Bertalanffy's remark that there are three types of description, in order of increasing precision

verbal
graphic (diagrammatic)
mathematical/logical

Recent work in cybernetics and systems has diverged into two streams, one focussed on mathematical presentation, the other on verbal—perhaps reflecting the different foci of the two original strands of cybernetics: Wiener and the Macy conferences (control and communication, and circular causal and feedback mechanisms). The central stream, represented in diagrams, has become less apparent. It is strange that the two favoured streams are essentially similar (see later), while the one omitted is the one that is quite different.

The power of diagrams

Many people are well aware of the power of diagrams. This power is one reason for the ascent of professions such as graphic designer, and is an area of increasing importance as the question of data visualisation grows more important and bigger while our computers generate more and more data.

One of the best known diagrams in the world is the London Underground (tube) Map (see http://

www.melted.com/bce/images/underground%20map%20net.jpg). It is hard to overestimate the influence of this map terms of graphics (the removal of the Euclidean geometry while maintaining the topology has been mimicked in countless city transport maps, airline routing diagrams etc.), but also in terms of how people learn to understand and navigate London. For many, the simple topological continuity of the tube lines gives a straightforward coherence by which they can navigate the complex geometry of the roads on the surface, structuring what to many is vast and chaotic. The simplification inherent in the making of any model has immediate and powerful effect in such diagrams. (There are early precedents going back to at least the 11th century when maps of pilgrimage routes were often drawn as straight lines.) In the case of the London Underground Map, the logic of the system is shown by concentrating on what is important: who cares about the curves in the track (specially when they are dark)? What matters is the access points, the connections and the interchanges. The tube map expresses the salient factors in the working of the tube system through a powerful and effective visual logic.

Different styles of thinking and conceiving

Roger Sperry [1968] argued that the two hemispheres of the brain handle essentially different sensory material in different ways. He distinguished a logical and a visual tendency. Although the exact distinction he drew is questioned today, what is not questioned is that there is a difference. We construct our worlds using more than one style.

Not much later, Gordon Pask and Bernard Scott [Pask, G and Scott, BCE 1972] were amongst those who argued that there are distinct learning styles that are radically and structurally different. Initially, they distinguished two main styles: serialist and holist. It would not be hard to map these into Sperry's distinction between logical and visual.

Thus, work in the areas of brain function and style of learning both suggest a distinction in how we might present material and argue cases: in a (logical) form, which has become the norm; and in a visual form. In other words, as well as words and their derivatives mathematical and logical formulae (which are essentially serialist—left brain—processes) we have the alternative of holistic processes (right brain, holist).

Wholes and parts and a different logic

Pask, working with colleagues at his research organisation System Research, developed, in his Entailment Meshes [Pask, G, Kallikourdis, D and Scott, BCE 1975], an important structure that sustaining both these approaches to learning styles. The learner can start anywhere and move step by step towards a selected goal, developing an understanding built from discrete, logical connections: or can jump all over the place, building a patchwork in which the goal comes more and more into focus.

In Pask and Scott's early work on learning styles, there are essentially two distinct types of logic used by two styles of learner who might study in Entailment Meshes. (Pask originally argued that these styles were mutually exclusive, but later changed his mind: in my view, the scale of undertaking his subjects were involved with had lead to this notion of exclusivity, which was found not to hold when the scale was increased and subjects had time and reason to change their approach.)

The first is the familiar type of logic that moves step by step in a deductive chain in which the start point is linked to the end point with a necessity and inevitability. In effect, this is a narrative.

The second is one where, while such a narrative can indeed be constructed, it is constructed after the event. (In this respect, it is like design. [Glanville, R 2005a]) The connections made are not exclusive but inclusive. This is the sort of logic that Gregory Bateson [1978] argued for as the new logic through we should consider the world, in his final paper "Men are Grass." Bateson characterised this logic as not being based on the exclusion of the choice either/or but on the inclusion in thinking both/and.

Architectural perception

At around the time of Sperry and Pask and Scott's work, I carried out a series of experiments in how architecture students form understandings of architectural space. These contrasted with the prevailing views in Environmental Psychology in that they were searching for variables (if, indeed, there were any) rather than assuming them. The outcome was the discovery that the perception of space is as a whole that is then enriched with detail, rather than a careful assessment of a number of variables being forged into a sense of the whole. What was, at the time, known as the "wow!" factor was crucial [Glanville, R 1977].

Logic, time, instants and sequences

Time is not generally understood to have any role in logic: logic simply states the outcome of legitimate relationships between propositions and such like. Nevertheless, at the same time I developed a time based logic [Glanville, R 1975]. Note that, in the sense that all logic is made up of propositions and connectives that are applied in sequence, all logic is time based. But in the sense that the logic grows out of time itself as the material of its construction (as opposed to a sequence of spatial connectives), it is not. The logic came out of the time of involvement in the act of observing: time (of observation) itself made the connections. In talking about the development of knowledge, whether through a slow and logical building up or a patchwork enrichment, it is clear that time is important: not just as sequence but also as involvement.

Such a logic is necessary to support the notion of these two different ways of understanding, which Pask pointed to as holist and serialist learning styles and Sperry indicated through the differentiation between right and left brain processing. These differences, in turn, are crucial in allowing us to accept the value of visual logic, as for instance represented by the diagram, as a legitimate alternative way of describing and arguing. The holistic quality of visual perception, of our understanding of the diagram, complements the serial quality of logical perception, of describing in words and in logical formulations. And, while this was not von Bertalanffy's point, it is nevertheless central to the viability of his assertion.

Four cybernetic activities

Having argued the significance of visual presentation, of visual perception and the diagram, and having provided them with a context, I will now explore a particular diagram. This diagram is the one that I found myself drawing four times over in the keynote I mentioned at the outset.

Consider the following diagram consisting of one square, and one round "box", connected each to the other by an arc entering, and another arc leaving each.

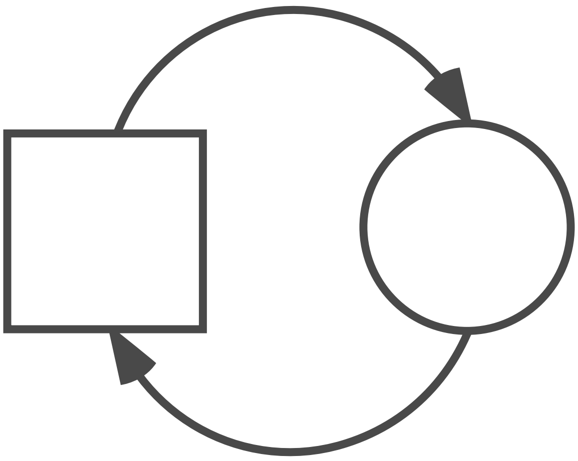

figure 1

This is a simple diagram showing a circular linking of two distinct and different items. I will now explore it in four different situations, occasionally extending it.

(Cybernetic) observing

Figure 1 can be seen as a diagram of a thermostat, commonly regarded as one of the simplest of cybernetic systems. The square represents the furnace/radiators, the circle the thermostatic switch, and the arcs the communication between them: from the square to the circle by heat, from the circle to the square by electricity. We can name the activity of the circle and the square concerning the other "observation." From the form of this diagram it is apparent that the system is circular: the causality is circular as per the Macy Conference title. Thus, there is no overall controller: the behaviour of the square "controls" the behaviour of the circle, and the behaviour of the circle "controls" the behaviour of the square. The circular system is the thermostat, which is what its name implies.

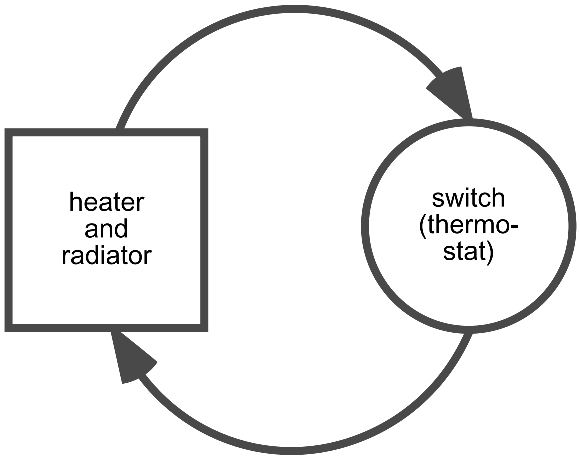

figure 2

What becomes immediately apparent in the diagram is the circularity and the interlinkedness of the square and the circle. This is the meaning of circular causality.

But I want to push this example a little further. We are inconsistent in the way in which we are observing the system. In the thermostat as we draw it, the observation is circular. Both circle and square are involved in a very simple act that we can consider as observation. But our position vis-a-vis our involvement as observer of this system is not circular: we describe the thermostat as if our observing had no effect: we are observers of it, as per this figure:

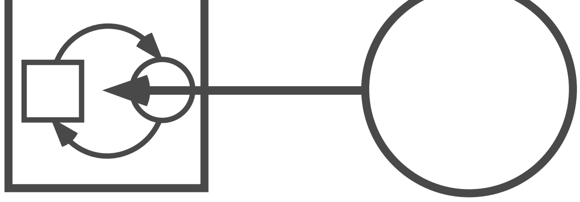

figure 3

Here, I have placed the thermostatic system within a square, and have denoted the observer by a circle, with a one way link: the arrow pointing from the circle to the square.

To be consistent, to cybernetically explore the subject matter of cybernetics (as Margaret Mead [1968] invited us to do), requires not that we simply gaze down on it, but that we recognise that it behaves and, in its behaving it changes how we behave. In this case, we need to join the observer to the thermostatic system by two directed arcs, and we have again the simple system of the square and circle connected by an arc entering and another leaving each. Thus, our observer and the thermostatic system (which is a circular system) also form a circular system. We have our observer in a cybernetic system and our observer (our circle) is a cybernetic observer.

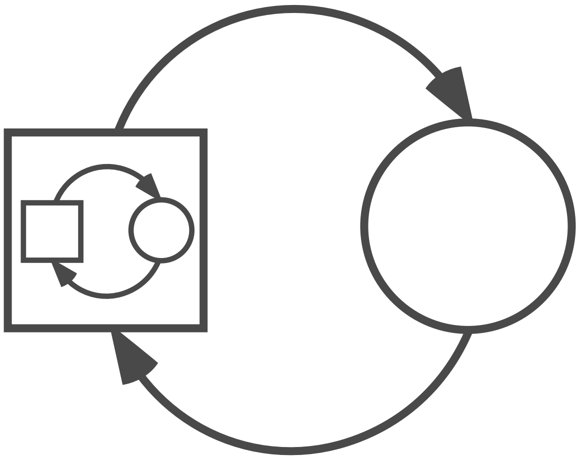

figure 4

Systems in which there is an "observer of" are often called first order cybernetic systems. Those in which there is an "observer in" are second order systems. The diagram makes this clear, and shows the concatenative character of second order systems, opening the system to many important speculations which have provided the bedrock for second order cybernetic studies.

Designing

Now consider that the square in our ubiquitous diagram (figure 1) is a sheet of paper being marked by a pencil (or similar). The circle is a designer. What do we have?

The designer marks the paper (the arc with the arrow head entering the square) and then looks at the mark that was made (the arc with the arrow head entering the circle). The separation of the area of acting (the paper and pencil) from the source of action (the designer) allows the designer to look and find difference (as we shall see when we discuss conversing: the conversational nature of this act is essential.)

This is not to say that the circular activity of making marks, then viewing them; and then making more marks, is all that there is to design. There are many other aspects, including the tricky one of when and how to stop this process. But it is, as I among others have argued, the central, creative aspect even if not necessarily done with paper and pencil [Glanville, R and van Schaik, L 2003].

Learning

We will now look at learning, using that most cybernetic device, the Black Box, to consider how we may move from ignorance to knowing.

Let the square be a Black Box and the circle an observer who wants to learn. The Black Box is not an object in any conventional sense: it is a pseudo-invention of the observer placed to formalise a change (the arrow in and the arrow out are now seen as distinct, either side of the box, and can therefore be examined as in and out puts, with the Black Box hiding some supposed mechanism that might be taken to cause the change from input value to output value.

The observer, wishing to learn, takes the value of the observed behaviour of the Black Box (converting input to output) and comparing them proposes some "mechanism" that causes the change. To test and refine this proposal, the observer returns the output to the Black Box as a new input, comparing this input to the output that eventuates, building a description that seems to be of what happens in the Black Box.

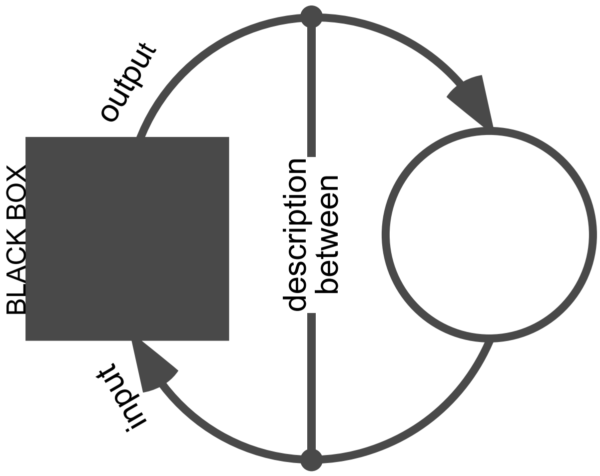

figure 5

But remember that the Black Box is a fantasy: it causes nothing. Nor, because history is no guarantee of future behaviour, can any regularity found—that is any "mechanism"—be guaranteed to be valid on the next cycle: what the observer has learnt is at best tied up with the history of an account built of an interaction, to date. In an important sense, the knowledge built is built on a profound ignorance, and depends on this deep ignorance for its possibility. And that the knowledge built is not of the Black Box, not of the observer, but is shared, an outcome of their interaction through circular sharing.

Conversation

Finally, we will consider communication—an area so central to cybernetics that it is singled out (along with control) in Wiener's original definition. Often, when we discuss communication, we are using a model that is based on a form of coding: put far too simplistically, meanings are in words, there should (ideally) be no ambiguity. But consider, for instance, learning. Teachers cannot do a learner's learning for them. It is for the learner to learn, to make whatever understanding works. This places the onus for understanding (which I am taking to be synonymous, in these circumstances) with making meaning with the learner. From this insight, Pask [Pask, G, Scott BCE and Kallikourdis, D 1973] developed a whole theory of communication ((and thus of being together), Conversation Theory.

Under these teaching/learning circumstances, we cannot assume that communication is a code: rather, it is a conversation. What happens in a conversation? This can be understood from our ubiquitous diagram. Each of the (minimum of) two participants—the square and the circle in the diagram—expresses their understandings in a public space that is shared with the other participant. These expressions are passed round and round, each participant making their own meanings in a continuing circle.

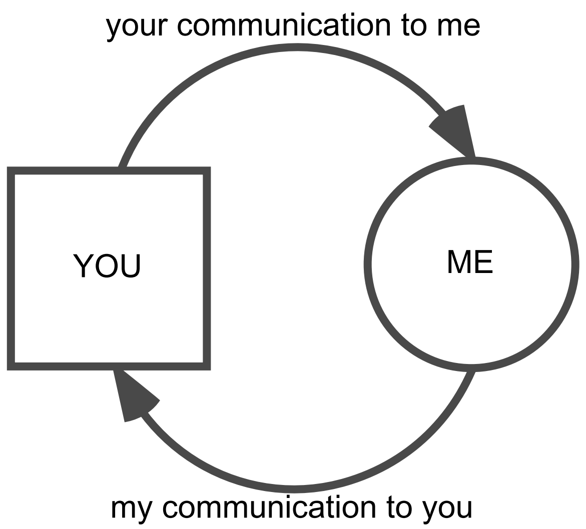

figure 6

All participants in a conversation are different, and the understandings they make cannot be considered as the same, so the individual difference leads to individual insights and directions that allow conversations to meander, moving over time through areas of discussion in such a manner that we are often surprised by where we end up; and, equally, these differences, if we can grab them, allow us to develop our understanding and thus to invent the new. Conversation is inevitably a source of creativity and originality.

Summary

All four of these activities, observing, designing, learning and communicating can be seen to take the same basic form, which becomes clear from the one diagram that serves to describe all of them. Thus, they can be seen as identical in certain respects, meaning that they are strictly analogous (homomorphic) to each other, or, put another way, that there is an area of identity between them.

In the case of one example, observing, the original diagram (the diagram of the thermostat) was expanded so that there was a second order of description which, however, mirrored the first order. Thus the relationship between first and second order systems is simply shown. In this we see not only concatenation but also consistency. Concatenation, as depicted, is a kind of implication

What is also seen with great immediacy is the circularity of the process, the form: in other words, the circularity causality of the Macy title.

There is a type of logic here that is immediate and which may lead to places it is hard to reach (or perhaps even conceive) using the linear logic of words and formal statements. Thus, the importance of betweenness (and thus sharing) has become clear in our investigations. Elsewhere I have argued about just how significant this betweenness is [Glanville, R 1999].

Conclusion

There are many meanings that have been intended when the term "Visual Logic" is used. Often the term is used to indicate diagrams illustrating conventional logical arrangements, such as Venn diagrams. The term is also used in art criticism and assessment, where Visual Logic is often intended as a way of indicating a consistency in composition (for instance): that there is some discernible ordering that is, perhaps, difficult to talk about except by allusion. Other examples would include the whole field of design semiotics and interpretation.

The way I have chosen to use the term "Visual Logic" has concerned the construction and interpretation of similarities through the use of diagrams of structure and form in systems. I have interpreted one diagram to explain four distinct activities. I have carried out some basic logical manoeuvres on that same diagram and have shown how characteristics that were perhaps invisible, or at best difficult to explain, can be easily pointed to. This is not the same as illustrating logical operations a la Venn Diagrams.

This was carried out against a background and context that recognise a difference in ways of thinking: in frontal lobes, in learning styles, in spatial perception and visualisation, reflected in a less visual logic. And that the instantaneity of the visual has special qualities to recommend it.

In this paper it has only been possible to show that there is power in this approach. There is much to be developed, but there is at least the comfort of knowing that there is probably something at the centre, and, therefore, that the effort might be worth it.

References

[Bateson, G 1978] Gregory Bateson. Men are Grass—Metaphor and the World of Mental Process, in Thompson, W (ed) Gaia—a Way of Knowing: Political Implications of the New Biology, Great Barrington, Lindisfarne Press, 1978

[Glanville, R 1975] Ranulph Glanville. A Cybernetic Development of Theories of Epistemology and Observation, with reference to Space and Time, as seen in Architecture (Ph D Thesis, unpublished) Brunel University, 1975

[Glanville, R 1977] Ranulph Glanville. Amazing Space: for the Architectural Stimulus-response Rat? AAQ, London 9—2/3, 1977

[Glanville, R 1999] Ranulph Glanville. Acts Between and Between Acts in Ascott, R (ed.) Reframing Consciousness, Exeter, Intellect, 1999

[Glanville, R 2005a] Ranulph Glanville. Design Prepositions keynote lecture at the conference The Unthinkable Doctorate Brussels, April 2005 (to be published in the proceedings)

[Glanville, R 2005b] Ranulph Glanville. Knowledge and Design in the Era of Second-Order Cybernetics, keynote address at The Many Interpretations and Applications of Cybernetics, annual conference of the American Society for Cybernetics, Washington DC October 27–30 2005

[Glanville, R and van Schaik, L 2003] Ranulph Glanville and Leon van Schaik. Designing Reflections: Reflections on Design, in Durling, D and Sugiyama, K (eds) Proceedings of the third conference, Doctoral Education in Design, Chiba, Chiba University, 2003

[Mead, M 1968] Margaret Mead. The Cybernetics of Cybernetics in von Foerster, H et al, (eds) Purposive Systems, New York, Spartan Books, 1968

[Pask, G and Scott, BCE 1972] Gordon Pask and Bernard Scott. Learning Strategies and Individual Competence, Int Jnl Man Machine Studies, Vol 4, 1972

[Pask, G, Kallikourdis, D and Scott, BCE 1975] Gordon Pask, Dionyssius Kallikourdis and Bernard Scott. The Representation of Knowables, Intnl Jnl for Man Machine Studies, Vol 17, 1975

[Pask, G, Scott BCE and Kallikourdis, D 1973] Gordon Pask, Bernard Scott and Dionyssius Kallikourdis. A Theory of Conversations and Individuals (Exemplified by the Learning Process on CASTE), Int J for Man-Machine Studies 5, 1973

[Sperry, R 1968] Roger Sperry. Hemisphere Deconnection and Unity in Conscious Awareness, American Psychologist vol 23 no 10, 1968

[Warfield, J 2005] John Warfield. Posting on CybCom list, November 5, 2005