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Iconicity in Cognition and Communication

*Christina Ljungberg**

Abstract: »*Ikonzität in Kognition und Kommunikation*«. Iconicity is fundamental to creative processes of reasoning such as modelling. We use models not only to orient ourselves in the physical world surrounding us but also as ways to sketch out problems by “mapping them,” describe processes, or make decisions by using models such as diagrams, maps, or schemata. Mental images are icons, and icons can lead to new and rare insights and to the discovery of relations that would not be recognized without their iconic representation. Discussing the relationship between modelling, reasoning, and creativity, this contribution argues that iconicity is essential to reasoning, communication and mutual understanding, besides being inherently performative. The paper demonstrates its argument with examples from picture viewing, map reading, and mental diagrams in verbal language.

Keywords: Iconicity, diagrammatic reasoning, modelling, analogy, similarity, visuality, performativity.

1. Introduction

Thinking involves experimentation, trying out various possibilities. Besides other cognitive instruments such as words, images and other signs, a model is one of the heuristic devices that we deploy in such experimental contexts in order to probe and explore new fields of thoughts and ideas. Models are internal (mental) or external diagrammatic representations. This is why iconicity – the general characteristic of mental images – is essential to cognitive processing; it builds on perceptual similarities and contrasts. We depend on models, not only for orienting ourselves in our physical environment but also for the ways in which we sketch out problems by “mapping them,” describe our experiences or make decisions by means of diagrams, maps, and schemata. Iconicity is fundamental to constructing models because mental images are icons, and interpreting icons can lead to the discovery of relations not otherwise recognized so that new and even surprising insights may be obtained.

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2. Iconicity

Iconicity is a semiotic concept introduced by Charles Sanders Peirce, the founder of modern semiotics. Peirce divides signs into three classes, iconic, indexical and symbolic, with respect to the way each sign relates to its (dynamic) object. Indices stand in a real or causal relation to the object they indicate; symbols are related to their object by habits or conventions, while icons are, roughly, associated with their objects by being, in some way or other, similar to them. This similarity can be a visual likeness in the sense that the sign resembles the form or colour of its object, but it may also be of an abstract kind, in the sense that it merely represents its structure, in which case the icon is a diagram. A diagram may have the form of external representation, on paper or as a three-dimensional model, or it may be a mental image of the object it represents. In the sense that interpreting and understanding a sentence, for example, or any other kind of information, means understanding how its constituent parts are related, *understanding* means creating a mental diagram (see Nöth 2015).

2.1 Iconicity and Analogy

Analogy, as Aristotle defines it, “is when the second term is to the first as the fourth to the third [and] we may then use the fourth for the second, or the second for the fourth” (*Poetics* 21). In the study of iconicity, analogy comes into play when we go one step further and subdivide the icon into its three Peircean subclasses of images, diagrams and metaphors. Whereas icons of the image type resemble their objects by some distinguishing features, and diagrams represent the mere structure of their object, a metaphorical icon is a sign that evinces a relation of similarity to some other sign, which is mediated by a third (the classical *tertium comparationis*). Metaphors are thus iconic mediators between ideas. As Mark Johnson (1981, 42) points out, “all theories are elaborations of basic metaphors or systems of metaphors”. As far as metaphorical models are concerned, the focus is on diagrammatic iconicity. Both scientific and technological models as well as creative thought processes are essentially diagrams. Any analogy is a diagrammatic icon since it represents a parallelism between the structures of two conceptual domains – forming a structure that makes the relations between diverse objects, external or internal, more intelligible.

Take, for instance, a map. For a geographical map to fulfil its function, there must exist a “structural analogical relationship of the scaled topographic map to reality” (Woodward 2001, 56). A map represents points in space that are diagrammatically arranged by means of map signs. Even though map signs are culturally constructed, the structural similarity of a map to its territory is a concept that, as Woodward argues, is “fairly readily understood” (2001, 56). This is what enables the map maker as well as the map reader to visualize a

region or a route, project its development or implementation, or to make thought experiments by modelling a plan of action. It is this diagrammatic modelling that links cartography so closely to the nature of human cognition and to our orientation in real space. Models such as maps are ideal instruments for orientation, since they possess the unique facility to permit us both to “enter” the map, position ourselves on it and within it as well as above it, allowing us to visualize our position inside it as well as the “full picture” from above. This is why the diagrammatic icon is our main interest in this paper. Diagrammatic iconicity is the prototypical characteristic of reasoning since reasoning is to arrange ideas diagrammatically.

3. The Relation between Modelling and Reasoning

“Diagrammatic reasoning”, as Peirce (CP 2.272) calls it, is the only cognitive procedure by which we can obtain new knowledge. A diagram only shows the relations existing between its constituents; it does not interpret them. Interpreting is reasoning, and in the process of interpreting the relations presented by a diagram, its interpreters can make diverse inferences by which they may obtain insights that the diagram itself does not convey. This is why observing a diagram can create new knowledge.

3.1 The Creative Process of Picture Viewing

To illustrate this I would like to have a look at a picture such as Pietro Perugino’s *Christ Delivering the Keys of the Kingdom to St. Peter* (ca. 1481-2, Figure 1), which is, strictly speaking, a diagram employing the main elements of the central perspective – horizon line, vanishing point and orthogonal lines. Since the actors in the foreground, being centrally and symmetrically placed, attract our immediate attention, this is where we start. What we see up front is an event, carried out by the two actors in the center, one standing and one kneeling, with a large key in profile connected to a second key held by the figure to the left, who is in the process of handing it over to the kneeling figure on the right. We can tell that these two actors are the most important ones because of their position in the painting and that the significance of the gesture of reverence is shown by the surrounding group of people. Because the audience are all so closely observing what is going on, this effectively draws our attention to the center, too. Further back, behind the front actors, we discern some smaller characters, who look as if they were standing on top of the front actors’ heads. We also see an open square with lines that converge on the doorway of the temple in the background, making clear that this is the door for which the keys they carry will fit.

How do we process this picture? By using “diagrammatic reasoning”, we employ the picture as a diagram of perspective and mentally calculate the distances between the various objects that it represents, and thus we draw our conclusion on how the objects are related in their topographic and social space. First focusing on the two figures up front, the bright open space between them has us move our gaze towards the horizon line guided by the diagonal line behind the head of Christ, then connecting them with the temple door, which is diagrammatically positioned where the projections intersect at the picture’s vanishing point. Viewing the picture thus means that we, in a process of experiment and discovery, can gain new information from the picture sign by manipulating its parts according to certain rules – and in so doing, acquire information about how the objects making up the diagram are interrelated. From there, we infer what the scenario means.

Figure 1: Pietro Perugino, Christ Delivering the Keys of the Kingdom to Saint Peter (ca. 1481-82). Fresco. Rome (Vatican), Sistine Chapel



Public Domain: Wikimedia commons.

One could well object that the event the painting represents is a well-known Biblical narrative that legitimates the Christian Church and that diagrammatic reasoning is therefore unnecessary. Does the image not simply depict what the title states? It is true that the title is necessary to indicate the names of the two protagonists in the center, but otherwise a viewer familiar with the cultural background in general can come to an understanding of the painting’s meaning by using diagrammatic reasoning alone. Even ignoring the main event portrayed in the painting, the diagram it forms make viewers understand that the

act depicted is of major importance. While keeping in mind that Perugino's use of the then newly invented Renaissance convention of perspective is unique to Western art and may therefore not have the same impact on a non-Western viewer, the suggested relationship between the gesture, the key and the temple door would incite as well as aid most viewers to solve the riddle of its meaning.

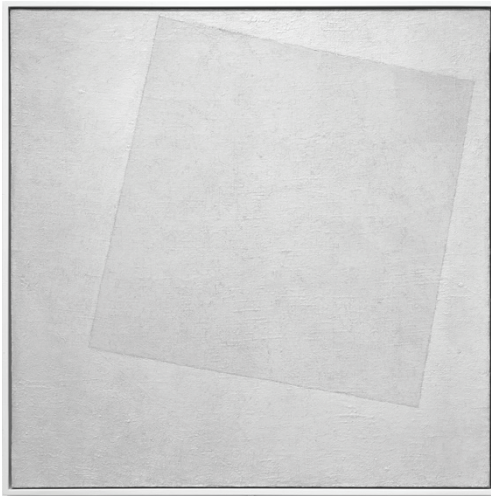
3.2 The Performativity of Diagrams

This example shows why the convention of the central perspective has been enormously successful in the history of painting. Centering everything on the eye of the beholder, it functions, in the words of John Berger, "like a beam from a lighthouse" since "[p]erspective makes the single eye the center of the visual world" (Berger 1968, 16). By this device, the painting becomes a diagram, instigating diagrammatic thinking, and since this process is less about the concrete shapes and forms of the figuration represented than about the dynamics, it opens up the potential relationships it depicts. This points to the performativity of diagrams: by inciting diagrammatic reasoning, which is less about structure than about manipulation and experimentation, thus trying out prospective alternatives, it produces new information and insight and, in so doing, creates new knowledge.¹

Diagrammatic reasoning also functions when we try to understand paintings with less explicit diagrammatic structure and symbolic content than in Perugino's painting. Even contemplating a picture such as Malevich's *Suprematist Composition: White on White* (1918, Figure 2), one of the best-known examples of twentieth century avant-garde Russian art, helps us consider various alternatives and come to an interpretation. Malevich's picture has often been given a mythologizing reading involving a quasi-mystical experience (Faerna 1996). While its negation of figuration and pictorial composition has been interpreted as a "leap into a mystical beyond, inner as well as outer" (West 2017, 92), which enables the viewer "to penetrate the universe through our imagination" (Hultén 1965), diagrammatic reasoning reveals intriguing material and phenomenological conditions seldom taken into account.

¹ For an interesting analysis of Perugino's painting from a different perspective, see Michael Marrinan's essay 'On the Thing-ness of Diagrams' (2016, 28-9).

Figure 2: Suprematist Composition: White on White. Kasimir Malevich (1918).



Public Domain: Wikimedia commons.

Despite its title, the painting is not monochromatic, especially if we compare it to Yves Klein's *IKB 79* (1959).² In contrast to Klein's blue, one of nearly two hundred monochromatic blues, in Malevich's painting white is not just white but a bluish square with imprecise outlines placed asymmetrically on a beige background. This does not only put colour designation into question but since figure and background are only distinguished by a minimal difference, the viewer gets the impression of seeing the figure placed on top of the background. However, as Frederik Stjernfelt (2007, 288) has pointed out, the square could even function as an ambiguous pattern, a *Kippfigur* shifting between object and background so that the object changes from being an object in the foreground and instead becomes a hole in the background, opening towards something else – or a void? Even though the difference between the two surfaces is minimal, one could also imagine that the square could refer to a zone of gravitation, which makes the square's oblique position one of instability, threatening to disappear into the background. It is precisely this diagrammatic relationship between figure and ground that gives the painting its compositional

² The comparison between Malevich's *White on White* (1918) and Klein's monochromatic blue *IKB 79* (1959) also clearly demonstrates the difference between a diagram and an icon of the image type. Whereas Malevich wanted his art to express "the supremacy of pure feeling or perception" (MOMA 1999, 85), which would seem to correspond to an image icon, it is Klein's holistic aesthetic which actually achieves this. As Klein writes, "Art does not depend on vision but on the sensibility that affects us, on affectivity therefore, and on that much more than all that touches our five senses" (Klein 1958, quoted in Stich 1994, 85).

tension and invites experimenting and acquiring or drawing further conclusions through diagrammatic reasoning.

4. Modelling and Creativity

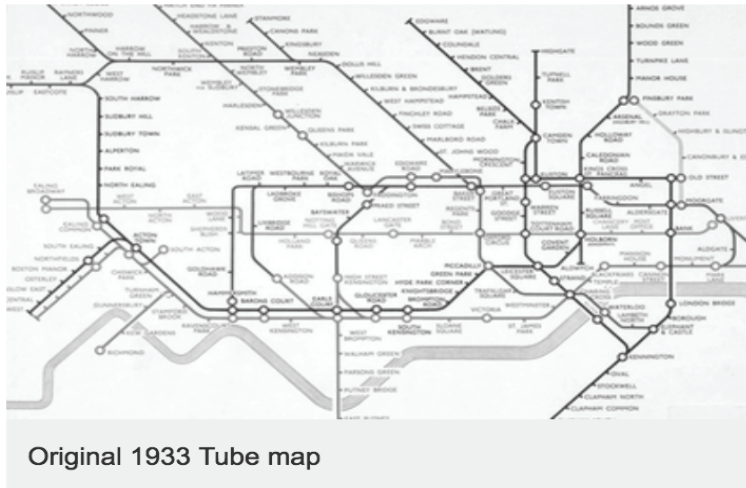
Material models are mental diagrams before they become external signs. They also live on as mental diagrams in the minds of those who interpret them. Material models such as maps are telling instances of how we operate on models to try out various possibilities, make decisions and, in so doing, find new solutions and create new knowledge.

4.1 Creative Solutions

Figuring out one's travel route on the London Underground Tube map (Figure 3) is an instructive example of how we operate creatively on a diagram. The map only shows the relationships between the various stations, without specifying the best connections between the point of departure A and a goal B. By experimenting on the various possibilities of finding the most advantageous route from A to B, including line changes, we are capable of modelling an itinerary that suits our purpose. The map *per se* does not mark the specific route we are taking. It is only by mentally manipulating the alternative routes offered by the map that we can obtain this information, that is, that we as users are able to trace new alternatives of new routes from the map. We may choose to change at different stations, or use a different combination of lines to avoid changing more than once – although the diagram does not directly indicate how to find the quickest and most efficient route.

A comparison between Harry Beck's famous map of 1933 and the first London Underground map of 1908 (Figure 4) shows how innovative Beck's map was. The London Metropolitan Railway – which was the world's first underground train line – had opened in January 1863 but, operated by several railway companies, developed so rapidly that it left passengers completely confused about how to find the easiest way to go from A to B. In 1908, finally, railway company operators united and pooled their resources to create a joint advertisement in the form of a free publicity map (Figure 4).

Figure 3: Harry Beck's original London Underground Map (1933), Transport for London



Source: <<https://tfl.gov.uk/maps/>>.

Figure 4: The First London Underground Map (1908)



Source: By Unknown, <<http://homepage.nflworld.com/clive.billson/tubemaps/1908.html>>, Public Domain, <<https://commons.wikimedia.org>>.

However, the amount of information collected on the 1908 map proved too complex for many travelers. Displaying the lines of the eight various railway companies, labeled and colour-coded, the relative positions of their stations along the lines, the station's connective relations with each other and the various fare zones, the map of the sprawling Tube network was quite a challenge for Londoners and even more so for visitors unfamiliar with both the locations and the system. In addition, the additional information of important destinations such as hospitals, main theatres, hotels and cemeteries included on the map cluttered it and made it difficult for its users to read and orient themselves efficiently.

What makes Beck's map so revolutionary is thus the diagrammatic reduction of a complex set of information into an operational network.³ By abandoning geographical detail entirely and simplifying the complex structure by geometrically straightening the lines to have the stations appear vertically, horizontally, or at 45 degree diagonals, Beck managed to represent the London Underground as a circuit diagram. First rejected by the publicity department on grounds that his design was too radical, the map was however granted a trial print run, which met with overwhelming success – this was exactly what the public wanted. That it became a template for transport systems worldwide and still is in operation after almost 85 years testifies to its merit.

4.2 Architectural Models

Similarly, in architecture, the strength of an architectural model or blueprint of a building is that while it represents the overall framework of a construction, its various interrelated parts can be changed, moved or discarded, allowing for an entirely new structure to be created that may not have been intended from the start. It abstracts from the concrete kinds of material in which it will be constructed, which is one of the key features of diagrams since this allows “the mind more easily to think of the important features” (Peirce 1998, 13). Nevertheless, as useful and productive as this kind of modelling are to those who are used to thinking visually, architectural drawings, like maps, need some practice to be mentally visualized and to convert the orthogonal plan into a mental diagram of a finished building. That is why architectural renderings, virtual two-dimensional images or animations showing the attributes of a proposed project, have become an indispensable tool for explaining to customers and politicians what the finished construction will look like.

³ As Kenneth Fields and William Cartwright (2014, 349) point out, Beck was most likely influenced by many maps, but he “pushed the boundaries and created something different, innovative and experimental”, which, I would argue, proves the strength of Beck's diagrammatic reasoning and subsequent reduction.

4.3 Mental Diagrams and Verbal Language

Mental diagrams are also at work in verbal language. We think in words, images and other signs arranged in mental diagrams – mental models – so that our thoughts can arrange and rearrange the diagram in mental experiments while probing and exploring new possibilities. Although words are symbols, they also evince iconic and indexical properties – otherwise they would be too abstract to represent anything. Iconicity, especially diagrammatic iconicity, plays a crucial part here. Syntactic deep structures are diagrams of what the sentences mean, and there is also iconicity in the sequential order of the words of our utterances. In the classical example, Caesar’s *veni, vidi, vici*, the shortness of the words is an icon of the short time in which Caesar conquered his opponents. Furthermore, as Winfried Nöth (2015, 23) points out, the order of the words is a diagram of the order of the events during that battle. Diagrammatic iconicity can be found at all levels of language use: at the level of sentences, phrases and words. Verbs, for example, involve mental diagrams of the agents involved in the action they represent.

Mental diagrams are systems and structures, and to the degree that language is a system that imposes structures on utterances and texts, verbal thought thus has diagrammatic form. Furthermore, a word is also a mental diagram of its phonological form, a mental schema of the order, the articulation and the stress pattern of how its vowels and consonants are to be uttered or written. That is why analogies are important to linguistic theorizing and modelling. Diagrams are important factors of language change, language evolution, and language acquisition, as the studies by Douglas Hofstadter (1995), Terrence Deacon (1997), Esa Itkonen (2005), Dieter Wanner (2006), Olga Fischer (2007), Winfried Nöth (2008) and others have shown, all of whom have given evidence that the basic mechanism of learning is analogy.

5. Conclusion: Iconicity as a Precondition for Communication and Understanding

Iconicity is then fundamental to communication and mutual understanding, in oral conversation as well as in writing and reading. It also plays an essential role in creative thought. It is the mental images, diagrams and metaphors triggered by icons that enable us to understand an utterance or create textual worlds from the little black marks on the page. While texts consist of symbols, that is, letters and words, these symbols create mental images of relations, fictional worlds in which we can move and which we can see in our mind, by applying our own experiences and cognitive makeup to the text. This, in turn, shapes our individual fictional architecture, its furniture and its cartographic imagination in the reading process – and accounts for the creativity it involves.

Iconicity thus plays a paramount part in cognition and communication. Observing a picture, orienting oneself in a text or finding one's way on a map are all complex creative cognitive activities involving modelling through diagrammatic reasoning, making use of analogy, similarity, and visibility in this process.

6. Discussion

Barbara Tversky had two questions to my position statement:

- 1) Peirce's diagrammatic reasoning – is all reasoning actually diagrammatic and the only way in which we can get new insights? Does diagrammatic reasoning really apply to Perugino's painting, which is so heavily loaded with religious symbols?
- 2) David Woodward quote: Barbara did not agree with Woodward's statement that there must exist a "structural analogical relationship of a map to reality" – as an example, she suggested a cognitive map, which does not need this "structural analogical relationship".

To which I answered

- 1) Diagrammatic reasoning, in the sense of C.S. Peirce (CP 2.272), is the only cognitive procedure that provides us with new knowledge. This is because a diagram only shows the relations existing between its constituents but it *does not interpret them*. Interpreting is reasoning. In the process of interpreting the relations presented by a diagram, the interpreter can make diverse inferences by which the interpreter obtains insights that are not conveyed by the diagram itself. That is why reading a diagram *can* result in new insights that the diagram itself does not formulate. As I argued, even though the title of Perugino's work clearly states the name of the two protagonists, a viewer unfamiliar with the cultural background could arrive at an understanding of the painting's meaning by diagrammatic reasoning only, without knowing the Bible narrative. The relationship proposed between the gesture, the key and the temple door provides clues for solving the meaning of the picture.
- 2) My point does not concern "cognitive maps" in the usual sense but geographical maps – a geographical map does not fulfill its function if it does not have a "structural analogical relationship" to reality, which is what it is made for, otherwise people could not use it for orientation. At the same time, all maps could be said to be cognitive as well as being "protocols of cognition" – they inform us about their own processes of creating meaning by their selection of and the relation in which they represent the objects in question.

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