Scientific Representations: A Philosophical Perspective

Marie-Pierre Hasne, Ph.D.

Principles & Practice of Data Visualization

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What is an image?

"The Greek sense of "image"—if we may use this word at all—is "a coming to fore", phantasia, understood as "coming into presence". Thus we are approaching the very intimate relations between presence, image, change and phantasia. Here we come to the fantastic intersection. Everything that comes into presence arrives changes, substituting itself for itself. This is the original ontological phantasm. Presence originally exchanges itself in return for its modification."

C. Malabou, Plasticity at the dusk of writing, 2009.
“The original imaging is in fact the history of presence. Originally, presence is change because it reflects a coming into image—phantasia. To be present is to enter phantasia, that is, the very mobility that shows (itself).”


**Phantasia or Fantasy:**

The Greek root “phos” derived from “Phaos”: light and phanein: to show, to appear

Phantome, fantasy, fancy: an appearance

Emphasis: Greek, em: in

Photograph: light-writing

Phenomenon: earlier spelling phaenomenon/phainomai: to be shown, or to appear. Originally was anything perceptible to the senses
On truth:

“Truth is a qualification which applies to Appearance alone. Reality is just itself, and it is nonsense to ask whether it be true or false. Truth is the conformation of Appearance to Reality.”

A. N. Whitehead, *Adventures of Ideas*, 1933
“We understand a statement as being true in a given situation when our understanding of the statement fits our understanding of the situation closely enough for our purposes”

G. Lakoff and M. Johnson, *Metaphors we live by*, 1980

“Truth is relative to understanding, which means that there is no absolute standpoint from which to obtain absolute objective truths about the world. This does not mean that there are no truths; it means only that truth is relative to our conceptual system, which is grounded in, and constantly tested by, our experiences and those other members of our culture...”

G. Lakoff and M. Johnson, *Metaphors we live by*, 1980
The scientific method and the place of the visual image
Inductive reasoning

Theory building approach

Obs. 1  Obs. 2  Obs. 3

Conclusion / Theory
Francis Bacon (1561-1626)
Gregor Mendel
(1822-1884)
1. Parents do not transmit their physiological traits or forms directly to their offspring. Rather, they transmit discrete information about the traits, called factors (=genes) that acts in the offspring to produce traits.

2. Each individual, with respect to each trait, contains two factors, which may code for the same form of the trait or which may code for two alternative forms of the trait (= diploid and alleles).

To explain his results Mendel proposed the following conclusions:

1. Parents do not transmit their physiological traits or forms directly to their offspring. Rather, they transmit discrete information about the traits, called **factors** (=**genes**) that acts in the offspring to produce traits.

2. Each individual, with respect to each trait, contains two factors, which may code for the same form of the trait or which may code for two alternative forms of the trait (=**diploid** and **alleles**).
David Hume
(1711-1776)

“If reason determined us, it would proceed upon that principle, that instances, of which we have no experience must resemble those of which we have had experience, and that the course of nature continues always uniformly the same.”

The Treatise of Human Nature
Deductive reasoning

Theory testing approach

Theory

Obs. 1 → Obs. 2 → Obs. 3
“Only the falsity of the theory can be inferred from empirical evidence, and this inference is a purely deductive one.”

K. Popper, Conjectures and Refutations
“In a science, on the other hand, a paradigm is rarely an object for replication. Instead, like an accepted judicial decision in the common law, it is an object for further articulation under new or more stringent conditions”.

“Scientific revolutions are inaugurated by a growing sense that an existing paradigm has ceased to function adequately in the exploration of an aspect of nature to which that paradigm itself had previously led the way”

“Paradigms gain their status because they are more successful than their competitors in solving a few problems that the group of practitioners has come to recognize as acute”

T. Kuhn, The Structure of Scientific Revolutions, 1962
Georges Seurat

*Un dimanche après-midi à l'Île de la Grande Jatte*
DIVISION OF LANGUAGE BY KARL BÜHLER

LANGUAGE HAS THREE POSSIBLE FUNCTIONS:

1-Expression; 2-arousal; 3-description

Animal + Human

Human

“If”
“when”
“not”
Allow for logical inferences
The visual image is supreme in its capacity for arousal, its use for expressive purposes is problematic, and unaided it lacks the possibility of matching the statement function of language.

Arousal

Claude Mellan, “The napkin of St. Veronica”, 1649
“There is no elephant on the mat”

“If the cat sits on the mat...”

“The cat sat on the mat”

“The cat sits on the mat”

“A cat sits on the mat”
Jointly the media of word and image increase the possibility of correct construction

E.H. Gombrich, the Visual Image, 1972
The chance of correct reading of the image is governed by 3 variables:

**The code, the caption and the context.**

**Code:** black tiles for solid form

**Caption:** Beware of the Dog (Cave Canem)

**Context:** entrance of a house in Pompeii
Still Life, Jan Simonsz

Still life with a bottle of rum, Pablo Picasso

G. H. Gombrich, How to read a Painting, 1961
Code:

Royalist print form
the French Revolution

M.C. Escher, Solid and Hollow, 1955
Magritte, This is not a pipe
The facial angle
(Petrus Camper 1791)
What a picture means to the viewer is strongly dependent on his past experience and knowledge. In this respect the visual image is not a mere representation of "reality" but a symbolic system.

The verbal and contextual information jolts us out of the Beholder’s Share: the contribution we make to representations from the stock of images stored in your mind.

In science, images are theory-laden.
The easier it is to separate code from content, the more we can rely on the image to communicate a particular kind of information.
How does representation represents?

“In the case of representation by pictures, scale models, diagrams and maps: By selective resemblance and selective (even systematic) non resemblance”

This process is effective if the selection is understood or conveys information

B.C. Van Fraassen, Scientific representation, 2008
Chart or diagrams that are so powerful at displaying relations that are originally not visual but temporal or logical (example of a family tree)

Family tree of queen Victoria
http://www.dfiles.me/queen-victoria-family-tree-to-queen-elizabeth.html
The roles of the visual image in Science:

1- Scientific images do not aim at recording the visible, their purpose is to make visible.

Effects of *Kola acuminate* proanthocyanidin (50 μg) on bloodstream form trypanosomes observed by scanning and transmission electron microscopy.
2- The visual model serves as an organizing template for whatever other potentially relevant information the agent might possess, regardless of how that information is encoded. The visual image guides the agent’s recall of stored information by providing a guide to what, within the agent’s diverse store of information, is most relevant to be the required probability judgment.

3. Visual Image as Metaphor

Wright’s idea of an adaptive landscape:

In evolutionary biology, adaptive landscapes (types of Evolutionary landscapes) are used to visualize the relationship between genotypes and reproductive success. ... The set of all possible genotypes, their degree of similarity, and their related fitness values is then called an adaptive landscape.
Metaphor etymologically means transfer or transport. (Meta: across, over; Pherein: to carry, bear)

The metaphor is a vehicle

“to have command of metaphor is to have an eye on similarities” Aristotle

“The creative moment of metaphor is concentrated on this grasping of resemblance, in the perception of analogies.”
“A novel metaphor does not merely actualize a potential connotation, it creates it. It is a semantic innovation, an emergent meaning.”

P. Ricoeur, Creativity in Language, 1973
Images can suggest false trails but like scientific hypothesis can be tested and discarded.

Thinking in picture is not science but it is not unrelated to science either.

From Charles Darwin’s Notebook
"The original imaging is in fact the history of presence. Originally, presence is change because it reflects a coming into image—phantasia. To be present is to enter phantasia, that is, the very mobility that shows (itself)."

“The scientific mind can go astray if it follows two contrary tendencies: the attraction of the singular and the attraction of the universal. Where conceptualization is concerned, we shall define these two tendencies as characteristic of knowledge in intension and in extension.”