

IMAGES, MORPHOLOGY AND METAPHORS IN BIOMEDICAL RESEARCH

Imágenes, morfología y metáforas en la investigación biomédica

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ABSTRACT

Some of the key discoveries of the last two centuries of biomedical research can be represented through a sequence of influential images that were originally powerful metaphors. Metaphor, as a model of proposition that includes the two extreme types of diaphor and epiphor, can serve the purpose of representing knowledge in a dynamic way. Metaphors are images, and therefore they have an intrinsic morphological component but of a special kind: ambiguous. The idea, originally suggested by Wittgenstein and then elaborated by MacCormac and Rosch, that all objects corresponding to the word chair are not a fixed prototype is crucial to understand how the model of abstraction of an essence from observable entities can be abandoned.

Key words: Ambiguity; Biomedical Research; Morphology; Metaphor.

RESUMEN

Algunos de los descubrimientos clave de los últimos dos siglos en investigación biomédica pueden ser representados a través de una secuencia de influyentes imágenes que, en origen, fueron poderosas metáforas. La metáfora, como modelo de proposición que incluye los dos extremos de la diáfora y la

epífora, puede servir al propósito de representar el conocimiento de una manera dinámica. Las metáforas son imágenes y, por lo tanto, tienen un componente morfológico intrínseco, aunque éste es de un tipo especial: ambiguo. La idea, originalmente sugerida por Wittgenstein y luego elaborada por MacCormac y Rosch, de que todos los objetos correspondientes a la palabra silla, por ejemplo, no son un prototipo fijo es crucial para entender cómo el modelo de abstracción de un esencia desde entidades observables puede ser abandonada.

Palabras clave: Ambigüedad, Investigación Biomédica; Morfología; Metáfora.

1. INTRODUCTION: SOME INFLUENTIAL IMAGES AND METAPHORS IN BIOMEDICAL RESEARCH

Some of the key discoveries of the last two centuries of biomedical research can be represented through a sequence of influential images that were originally powerful metaphors. Figure 1 is Darwin's famous drawing representing the "tree of life", preceded by an "I think" that reveals the intuition of the origin of species. The metaphorical nature of this image can be understood if we remember

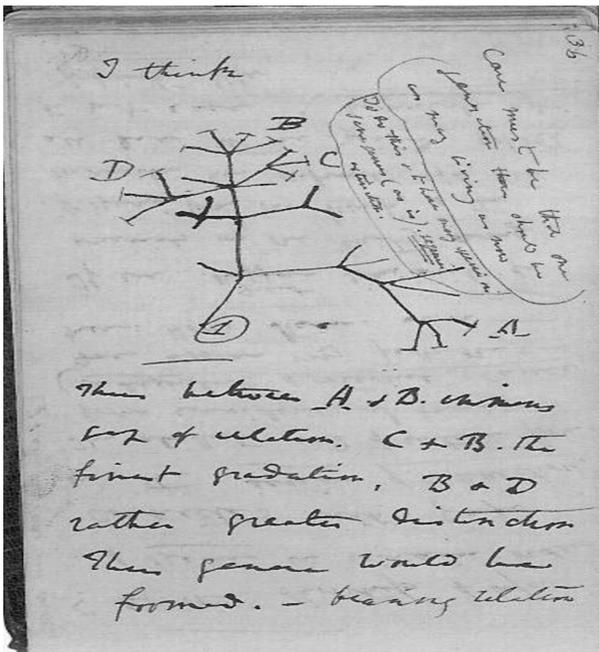


FIGURE 1.

that the current truth at the time was a-historical and creationist ("fixist"), with the species created at the same time and with no tree-like series of connections. Figure 2 is instead the first crystallographic image of DNA (obtained by Rosalind Franklin and Raymond Gosling in 1952), another morphological feature that led to a powerful and fruitful metaphor, the double helix. This image also clarifies the relationship between image and scientific creativity: the "double helix"

nature of the structure of DNA is not obvious from the image itself, and was instead constructed by Watson and Crick through careful modeling, i.e. a series of hypothetical models of the chemico-physical connections across the DNA bases, that could explain the crystallographic image. Though contemporary biomedical research is dominated by images, their role is not always acknowledged. Not necessarily they play the role of metaphors (i.e. leading to new hypotheses or discoveries), being rather simple heuristic devices.

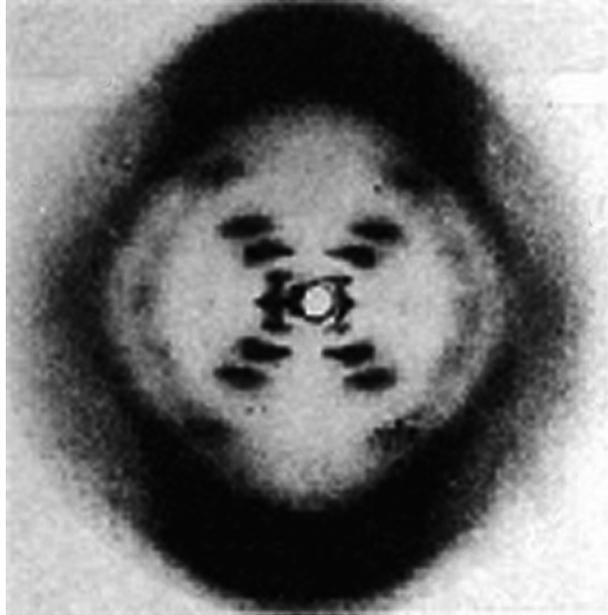


FIGURE 2.

For example, “Manhattan plots” in genetics are one of the many useful representations that have no other function than facilitating a decisional process such as in pattern recognition. In this case the plot allows the researcher to identify the strongest statistical relationships among hundreds of thousands of genetic or epigenetic signals measured in DNA, an image that has become familiar to many.

What follows aims at clarifying how morphology can be simply used for “functional images” with no heuristic value or may lead to powerful metaphors that allow discoveries.

2. A METAPHORICAL THEORY OF KNOWLEDGE

In his first conception of language Wittgenstein suggested an interpretation of the proposition as a “measurement tool”: the only true knowledge is scientific knowledge consisting in the description of “states of affairs”. The relation between proposition and state of affairs was allowed by a correspondence between words and objects (experience data), so that there is, between the components of the proposition, the same structural relation that exists among single elements of the “state of affairs”.

A descriptive proposition can also be compared to a miniaturized model of a ship, which has, on a lower scale, the same parts of the original. A model thus conceived has something that corresponds to the original and something that does not correspond, and the latter is supposed to be inessential for the identification of the real object. But if all propositions were of this kind, there would be no progression in knowledge: advancement would consist just in increasing detail—that is, the accuracy with which the original can be found in the model.

Let us consider scientific theories of cancer. In fact we never have “cancer” in its true essence in front of us, but only different ways of looking at malignant tumors: a morphological modality, based on microscopic description of cancer tissues; a genetic modality based on alterations observed in DNA; a biochemical modality based on metabolic malfunction of cells, and so on. An even superficial history of theories of carcinogenesis can easily persuade us that there was not at all an increasing ability to describe details of “cancer”—that is, something fixed, existing “there” outside our paradigms. Therefore the use of a proposition as a “measurement tool” is a condition (perhaps) necessary but certainly not sufficient to describe knowledge processes. The figure of speech that incorporates change across time is metaphor, which allows an enrichment of knowledge and not only an increase of detail.

In the theory of metaphor scholars have distinguished between those metaphors whose primary function is descriptive, and those whose function is suggestive. The former, called *epiphors*, are based on analogies in which the relation between the model and the “state of affairs” is obvious: “what corresponds” is thus prevailing in them. In the second type instead there is an anomaly, a lack of correspondence: they (*diaphors*) suggest new meanings by emphasizing the dissimilarities among referents rather than their similarities. An epiphor is a proposition whose correspondence with reality is not discussed, while a diaphor can contain those surprising elements that are typical of discovery (and, for that matter, literary communication). In the case of scientific theories, it is hypothesized that they are born as diaphors, and, if successfully validated, slowly become epiphors. For example, the word “force” as suggested by Newtonian physics was subject to a metaphoric use, obtained by juxtaposition of the meaning of force typical of Aristotelian mechanics and the new theory elaborated by Newton on action from a distance (gravity). The following experimental verification of the uses of this word transformed the diaphor into an epiphor, the expression of an accepted analogy instead of an uncertain and innovative suggestion.

Metaphor, as a model of proposition that includes the two extreme types of diaphor and epiphor, can serve the purpose of representing knowledge

in a dynamic way. Metaphors are images, and therefore they have an intrinsic morphological component but of a special kind. In the case of cancer theories, the idea that cancer was an infectious disease, transmissible by personal contact was for a certain period a diaphor, that was then falsified by epidemiological research (most cancers do not transmit by contact, although cervical cancer is due to repeated, long-term exposure to human papillomavirus). The hypothesis that cancer is a genetic disease (in a broad sense—that is, a disease related to DNA alterations) is a still vital diaphor. And the hypothesis that it is an environmental disease is an epiphor supported by clear and numerous observations (for example, the fact that migrants acquire the risk of cancer of the population into which they migrate). The elements that constitute the intrinsic image (analogy) in the metaphor are spatially (morphologically) related in a way that we examine later.

Let us see how, according to the analysis done by Ludwig Wittgenstein and, more recently, by Rosch, the use of the word “chair” and its understanding occur in practice. If I show a chair and pronounce its name, a listener who does not understand my language could think I refer to the wood it is made of, the legs, its red colour, the shallow surface or whatever other property. It is not just by the direct act of showing a prototype that the use of language is learnt, both because in showing the prototype I can be misunderstood about the meaning of my gesture (do I refer to the material, the colour or a part of the chair?), and because the listener will find herself in front of many other chairs whose correspondence with the prototype is only partial. It is not memorizing an abstract model that allows her to link the word chair with the relevant objects, but instead a continuous work of adaptation and rearrangement of the concrete uses of words that the community of speakers makes. Even if not all chairs have four legs, like the prototype, even if they do not have arms, and so on, the subject will identify, when examining the forms and functions of various chairs, those characters that allow her to talk about chairs in an appropriate way. Therefore, in addition to the description of prototypical situations, the literal use of language is also the product of a material interaction with the world.

MacCormac has defined the *literal* as the use of ordinary language to express concrete objects and events, noting that, however, the borders between literal and metaphorical are not clear cut. It is likely that, beyond prototypical situations, most literal uses of the language are “old epiphors” whose ambiguity has been progressively lost in the course of centuries. It is very suggestive, in any case, that the development and use of language are, in this interpretation, linked with a strict interaction with the material world: according to the concept used by both Wittgenstein and Simone Weil, “*originally was*

action” (a concept now reinforced by neurophysiological research on “*mirror neurons*” in the work of Giacomo Rizzolatti and others¹).

The idea, originally suggested by Wittgenstein and then elaborated by MacCormac and Rosch, that all objects corresponding to the word chair are not a fixed prototype –recalled by our mind in front of concrete chairs– is crucial to understand how the model of abstraction of an essence from observable entities can be abandoned. According to this simplistic inductive model, we come to defining what a chair is –or a protone or a chromosome– by progressive simplification, by giving up with the individual characters of single chairs; at the end of this inductive process a nuclear element, a single element that guarantees the unequivocal inclusion in the category, would be identified. This is what philosophers call “Merkmal-definition” (Merkmal meaning distinctive sign, feature) –that is, the definition would be allowed by the isolation of that unique crucial property– a necessary and sufficient condition –that makes a chair out of a chair, a proton out of a proton, etc. However many objections have been raised by Wittgenstein to this idea: a Merkmal is not always identifiable, and more often the word is used to indicate not a homogeneous and unequivocal set of observations, but a confused constellation with blurred borders. This constellation has been called a *fuzzy set*, and is at the basis of the semantic theory of metaphors by MacCormac.

Within the fuzzy set called “chair” we have, in a central position, the definition of chair that one can find in the dictionary; around this prototypal meaning there is a cloud of meanings, which on the one hand include ambiguous objects that serve to seat but do not have the shape of chairs, and at the other extreme ambiguous objects that look like chairs but do not serve for seating. The concept of chair gives up with a *monothetic* definition that is being amenable to a necessary and sufficient characteristic, to become “*polythetic*.”

3. FUZZY SETS

A fuzzy set is a set in which membership is not crisp (yes or no), but comes in degrees according to a function. For example, there is not a crisp distinction between cold and hot, but an intermediate category of warm with fuzzy borders.

The fact that many words are used as fuzzy sets –that is, with flexible meanings with blurred borders– assures the possibility of change and progress

1. RIZZOLATTI, G/CRAIGHERO. L., “The mirror-neuron system”, *Annual Review of Neuroscience*, 27/ 1 (2004) 169-192.

in knowledge. This is particularly true if the word plays an important role in a metaphorical proposition. If the word had a fixed meaning—that can be deciphered through a dictionary—the metaphorical extension that allows the development of new metaphors would not be possible. Diaphors would not exist if a word had not a prototypical meaning plus other meanings showing weaker links with the prototype within the fuzzy set. Inclusion in the category of objects defined by the word is determined by the “*distance of similarity with the prototype*”—that is, by similarities and dissimilarities between the object and the prototype. Strictly speaking, in Wittgenstein’s conception there is not necessarily a prototype, but a sequence of overlapping correspondences; the comparison that has been proposed is with a rope made of many different threads, none of which however is long like the rope itself: thus, in the case of the chair we have at the centre the prototypical chair, on one side a sequence of objects without four legs but serving to seat, and on the other side a sequence of objects that have four legs but serve many different purposes.

Metaphor comes from the juxtaposition of words apparently in conflict, at least in a diaphor; this contrast is sensible only if the meaning of the two words can be “stretched” sufficiently so as to allow the identification of a *perspicuous image* of the world. The fact that I say that cancer is formed by “crazy cells” has some possibility of succeeding only if the concept of craziness can be expanded in order to cover the biological behaviours of those cells that, invading surrounding tissues, conferred to breast cancer the aspect of a crab (= cancer) when the image of “cancer” was coined. MacCormac invites us to imagine the semantic space of a metaphor as a space in which different words are linked to each other by *vectors*. The length of each vector determines how strictly the two words are related. For example, “animated” will have a short vector that links it with “man” and “dog,” but a very long vector that links it to “locomotive.” Every language creation, from the poetic ones to the ethical and the scientific ones, is based on the proposal of new vectors that link, in a more or less convincing way, different words. There is obviously a relation between the length of vectors and belonging in a fuzzy set: an object with an ambiguous status, say between a vehicle and a children’s game (like a rudimentary chart) will have a weak linkage with both fuzzy sets—that is, it will be far from the prototypes of both categories, and will tend to possess very long vectors that link it to other objects that could be reasonably linked with the prototypes. A long vector that links two objects indicates that it is unlikely that the two objects can be reasonably included in a same fuzzy set; but this cannot be easily established a priori: who would have thought of a connection between crabs and madness, as in cancer?

How is the relation between metaphor and truth set, considering that those who formulate a new diaphor put themselves intentionally in the position of uttering an apparently false proposition? It is clear, first of all, that in this perspective it is necessary to abandon an absolute concept of truth, and introduce the idea of degrees of truth. Metaphor is a hypothetical utterance that needs verification. Truth or falseness are judged from how the different components of language link to each other: there is not a real direct comparison of constitutive parts of a metaphor with a state of affairs; rather, the words included in the basic similarity that underlies the metaphor are compared with events in the empirical world to establish the credibility of the similarity. As MacCormac claims: “A person who wants to formulate a new hypothesis or to express a deep emotion stretches the language metaphorically in order to produce new and deep meanings; certainly she does not create intentionally false propositions”.

4. CONCLUSIONS: MORPHOLOGY IN PAUL KLEE AND GOETHE: “NATURA NATURATA” AND “NATURA NATURANS”

Goethe –in addition to being a writer and a poet– also developed a scientific theory of morphology based on his observations of anatomy, geology and botanics. Also, Goethe developed an original theory of color (1810). Though the latter was found to be incorrect by subsequent observations, it was very influential at his time and for the following century. A painter who was explicitly influenced by Goethe’s morphology theory (such as in Goethe’s “Urpflanze”) is Paul Klee, who developed graphically his own concept of plant morphology². His painting “Uhrpflanzen” is based on the similarity between “Uhr” (watch) and “Ur” (original) in the German language, and describes imaginary plants in the shape of watches (Figure 3).

Klee’s conception of painting is highly relevant to the theory of knowledge I have sketched above. His paintings are all based on a central role of irony, defined by Shaftesbury as the way that humans have to enlighten truth beyond the conventions of language. Irony is the act of saying one thing with the goal of understanding another. This is what Klee did in his paintings but also what innovative science does when coining new diaphors. In Klee, coherently with what we have claimed above, the ironic understanding of reality was a dynamic conception of plastic signs, that entertained a play with

2. PAQUET, C., “L’influence de Goethe sur l’oeuvre de Klee”, in: *Paul Klee. L’ironie a l’oeuvre* [Cat.], Paris, Centre Pompidou, 2016.

ambiguity, used double meanings and polysemy and engaged the spectator in an active way³. This clearly resonates with McCormac's definition of the metaphor: "metaphor results from a cognitive process that juxtaposes two or more not normally associated referents, producing semantic conceptual anomaly, the symptom of which is usually emotional tension"⁴.

This dynamic, playful and ironic conception of art and knowledge changes our view of Nature itself. Like Darwin fought against "fixism" of species ("*natura naturata*" in Spinoza's words, i.e. an objectified Nature "our there"), we embrace a much more adequate conception of "*natura naturans*", an incomplete and constantly transforming process that we try to capture scientifically and artistically with our metaphors. (We have thus closed the circle from Figure 1 to Figure 3, both images of trees).

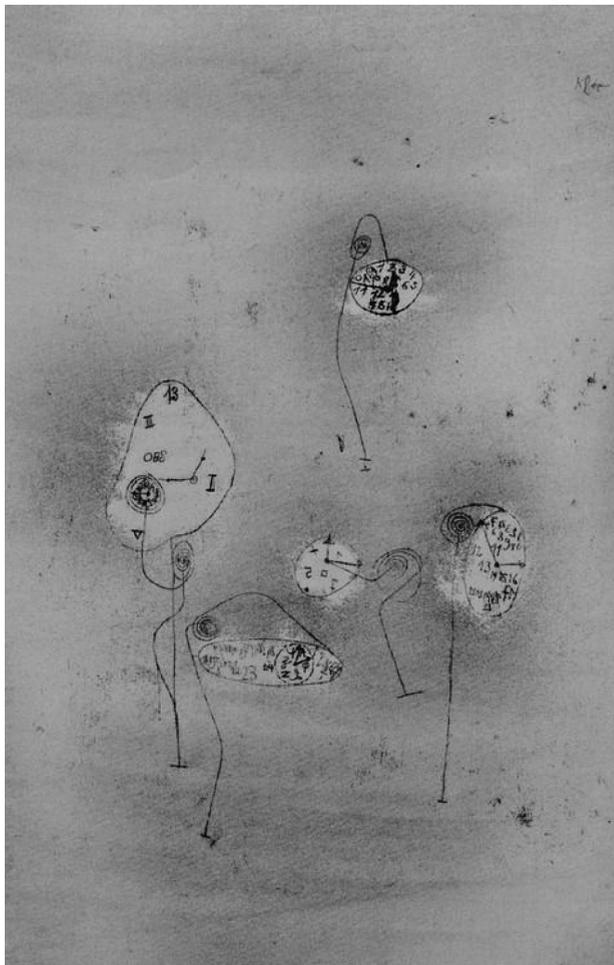


FIGURE 3. Paul Klee, *Uhrpflanzen* (Watch Plants), 1924.

3. *Ibidem*.

4. MACCORMAC, E. R., *A Cognitive Theory of Metaphor*, Cambridge, Massachusetts, The MIT Press, 1985.