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The Blind Spot of Neuroscience

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Abstract

Neuroscientists and biologists play a trick on themselves: they turn their subject of study into an object, while pretending they are not there. Such self-induced amnesia provides a convenient approach to the study of life and mind that, paradoxically, defeats its purpose. Here I argue that the notion of pure objectivity is a pervasive and pernicious form of naïve anthropomorphism. In treating subjects as objects (including ourselves), we pretend to erect "a view from nowhere". I discuss how perception, through the lens of magic and artificial intelligence, reveals its subjective nature. We are an inextricable part of the phenomena we study. Lived experience is the very condition of scientific intelligibility.

Keywords: subjectivity, neuroscience, magic, artificial intelligence, experience

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Neuroscientists have a conflict of interests that remains undeclared most of the time: a subject (the scientist) studies another subject (a human, a fly, a mouse, a worm) but pretends that the subject of study is an object (for instance, a brain), and that the scientist is not present. Note the trick: we start with two subjects and, without noticing, as in a sleight of hand, we end with one object (Figure 1).

Such conflict of interests involves a double challenge: (i) the problem of the observer, namely, the subject that carries out the experiment, and (ii) the problem of the observed, the subject upon which the experiment is carried out.

The problem of the observer brings us to the problem of objectivity. The question is whether it is possible to say something about reality as something "out there" independently of how or who observes it. Do we see the world as it is or, according to the ancient saying, we see the world as we are?

Physicists bumped into this problem exactly one century ago. They discovered that pure objectivity is a myth. The observer cannot be left out of the equation (Bitbol, 2019). The other sciences have resisted to this conceptual revolution without virtually modifying a speck of their approach (which in turn continues to be anchored in the premises of 17th natural philosophy and 19th century physics). And yet, the role of the observer cannot be ignored indefinitely. To wear a white coat does not make us disappear from the scene. Objectivity is built across subjects.

This brings us to the second problem: the problem of the observed. It concerns (at least) the sciences of life and of mind (Thompson, 2010), which include biology, psychology and neuroscience, amongst others. Here we encounter the following paradox: most biologists study life as if it were dead (Figure 2). As a corollary, it seems, neuroscientists study the mind as if it were a mere anecdotal product of cerebral matter. But I wonder: Is my genome in a USB stick actually a copy of me? Am I really my connectome? Drowning should not be considered a swimming style (Barfield, 1988). Nor will we understand living organisms by isolating them and then reducing them to pieces. The current approach to life and mind suffers from "the Frankenstein error" (Gomez-Marin and Ghazanfar, 2019)

This habit (which is a vice) of thinking the superior in terms of the inferior is a methodological and conceptual bias we have inherited from the rhetoric of 20th century molecular biology (Kay, 2000). That which affirms that life is nothing but biochemistry and, thus, that mind is nothing but electrochemistry. And yet, every time someone claims that "A is nothing more than B", one must remain sceptical (Noble, 2006). Love cannot be reduced to a brain scanner. You won't find the humidity of water amongst its molecules. Science is part of life, not the other way around.

Here we can invoke a marvellous idea: the *Umwelt* (Von Uexküll, 1992), which in German means world. This is not "any" world, or simply a generic world, but the world as experienced by each and every organism. Rather than the objective surroundings (for which the German have the word *Umgebung*), the *Umwelt* is the meaningful environment for the subject. Let us put an example: a stone is a stone, but a stone for a beetle has little to do with a stone for a human. For the beetle, the stone is a shelter. For the human, it may be an opportunity to hunt. To each their *Umwelt*!

There are as many worlds as living organisms, seach of them with its own particular way to look at (and act upon) the world. This observation leads us to the following discovery: all organisms share the world but not all organisms have the same world in common. Thus, when we study the behavior of a mouse in our laboratory by putting it in a small square box for a few minutes (Walsh and Cummins, 1976), it is very likely that our efforts to be objective end up being a misplaced projection.

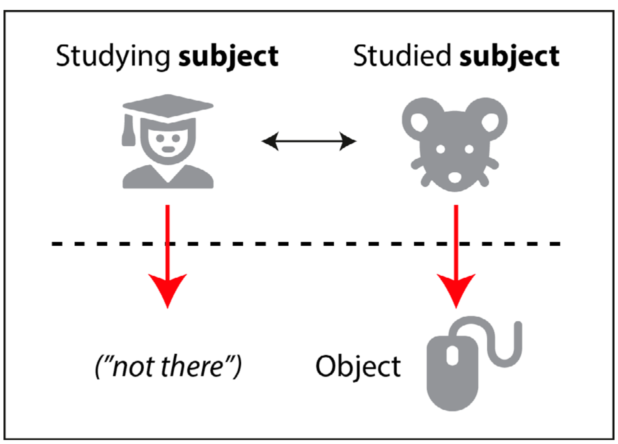

Fig. 1. A blind pursuit of objectivity removes the scientist form the scene and transforms the subject under study into an object.

We project our world, mostly in terms of abstractions or conveniences (i.e. square boxes are easier to build, pack and transport, and thus cheaper and more readily available), upon the mouse's world (which is never an *Umgebung*). Wouldn't we then fall into a subtle and sophisticated kind of anthropomorphism? There is a clash of *Umwelts* in our laboratories (Gomez-Marin, 2019).

By blindly embracing an objective frame (note the double oxymoron here), by forcing the subjective into the objective, scientists shoot themselves in the foot. It seems that, in order to tolerate the real, one must attenuate it. By means of the paradoxical structure of the double (Rosset, 1976), we make a copy and take it for the original. We thus arrive at the blind spot of neuroscience. As Morpheus put it in The Matrix, destiny is not without a sense of irony... since it seems that what science (and also often philosophy) cannot perceive is perception itself. The blind spot is thus not just an obscuration of a part of the field of perception (which we actually fill in). The spot to which we are blind is precisely what makes seeing possible. The blind spot is the neglect of lived experience (Frank et al, 2019).

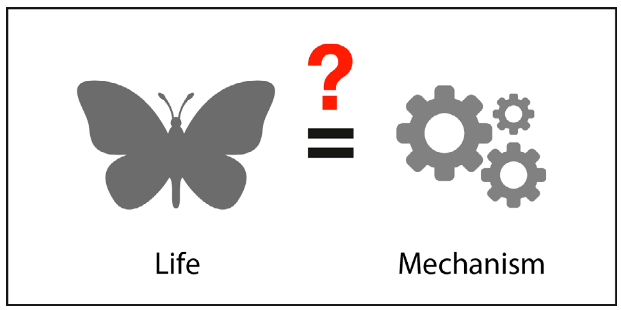

Fig. 2. Is a butterfly an undead mechanism?

To tackle this problem —and far from offering a solution—, let me devote the second part of this essay to share our efforts in this respect. In particular, I would like to discuss a proposal that uses and merges two rather unexpected elements: magic and artificial intelligence; let us call it "mAgIc" (Zaghi-Lara et al, 2019). Both are powerful mirrors to study perception and, more broadly, human cognition. At the same time, "mAgIc" represents a hybrid between the old and the new; since magic is a millenary art and AI a powerful technique undergoing a recent revival (in my opinion, both hyped and deserved). Let us start with magic.

Magic is the art to produce in the spectator the experience of the impossible. Note that one thing is to ignore how something takes place (this is actually a very common experience for the scientist in the presence of the workings of nature), while another is to be sure that what has happened cannot be (such is the experience of the spectator in the presence of the magician's workings).

It is important to remark that, for the spectator that experiences it, an illusion is arguably the "really real" (regardless of whether one wishes to call it true or false); that which one experiences concretely (Bergson, 2019), in the immediacy of one's first person lived perspective. Let us ponder the following example: the letters in Figure 3 have exactly the same intensity of grey, but only to the observer that looks at them without the grey gradient in the background (McCourt, 1982). Context is thus constitutive of content. The background is technically entangled to the foreground.

"Who are you gonna believe, me or your own eyes?" Groucho Marx's famous quote can be traced back to Goethe, who affirmed (and he did so very seriously) the reality of the optical illusion. Illusions reveal the ubiquitous presence of the mind in vision (Zajonc, 1995). Furthermore, there is no magic without spectator. Magicians are the only artists that cannot really perform their art to themselves. The experiencing subject is the kernel of the phenomenon of magic and of perception writ large.

In collaboration with a professional magician, we designed a series of simple tricks, this is, simplified but effective motor maneuvers, based on magic with coins (to make them appear, disappear, translocate, multiply, etc). First, we measured with great precision the movement of the magician during a sleight of hand (fingers, wrists, elbows, etc) in order to understand why and how his dexterity actually fools us. To that end, we used a computer vision algorithm based on artificial intelligence (Mathis et al, 2018).

To make a long story short, this is how it works: given an image, the human teaches the machine a point of interest in the image (for instance, the precise position of the nail of the right index finger of the magician, or where the coin is). This procedure is called supervised machine learning. By automatically extracting properties from the pixels in the image, and after only a few examples (this is the crucial part), the machine is, in principle, able to mark in any future image where the index finger will be. From "here, dear algorithm, is what a finger is" the machine learns and replies: "this, dear human, is where the finger is" (this actually works: https://youtu.be/KPizTPQz0tc).

But, what if rather than teaching the machine to "see" fingers or coins when they are visible, we would teach it to tell us where it "thinks" they are when not visible? Daring to track the invisible, one upgrades the machine from a mere tool to an "artificial spectator". The previous link also demonstrates that the machine can guess, as a human would, where the coin is. It is the human who infuses the machine with a kind of perception.

Next we presented the magic maneuvers to the computer. Where is the coin? A few short tricks are shown in the video, first as raw clips, and then with a red spot marking what the machine "saw". Do not blink. The hand is faster than the eye. In magic everything usually happens fast-enough so as not to leave much time to the spectator's analytic mind to discover what took place nor how.

Fig. 3. Visual illusions remind us that context is constitutive of perception, and that perception always entails perspective.

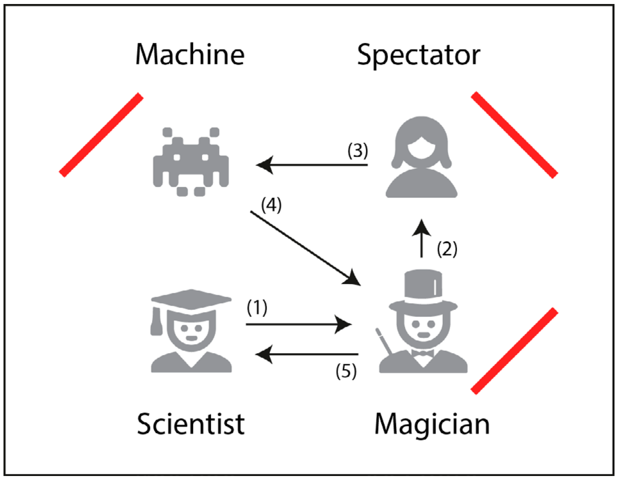

Fig. 4. Using magic and artificial intelligence as mirrors that reveal our blind spot in the act of perception.

Although magic is not meant to be served in a can, cold, suddenly, and devoid of preliminaries in a ten second video, I wonder if the magician nevertheless fooled you? Now you can watch the videos where the machine indicates where it thinks the coin should be. Do you think that the magician fooled the machine too?

We arrive at subtle realization: the point here is not about the magician telling us the trick so that we, neuroscientists, study it and then tell the magician why and how it works. No. It is more interesting to go in the other direction: to use what magicians know in order to study something that is present in our daily life, beyond the lab and the theatre, and that is both fascinating and scary: our mind fools us virtually all the time (Stephen, 1922).

But one may still ask: what about the machine? Does it learn or not? Did we really deceive it? Here we need to be clear and cautious. Machines do not “see”; they “detect”. They do not “attend” either, since they have no freedom to look at one side of the image but not at the other. Despite our colloquial use of terms, properly speaking, machines do not “think”; they “calculate” (Rosen, 2000).

Accordingly, the trick that we make to the machine is in reality a trick that we make to ourselves through what we have been able to hand over to it about our own *Umwelt*. Our approach to perception by means of “mAgIc” is thus a fun and fascinating mirror game (Figure 4): we ask the magician to make a trick to the spectator who then trains the machine so that, again in front of the magician, reflects and amplifies some of our own cognitive processes (Zaghi-Lara et al, 2019). A game of deforming mirrors in the line with the Greek aphorism “Know Thyself”.

Magic reminds us what we know but easily forget (specially when, like Dr. Frankenstein, we are so focused in our laboratories): that mind, like life, is contingent, sloppy, inexact; it improvises, errs, learns, invents, and improvises; it deforms reality as it deforms itself. The laws of mechanics are not broken in a broken clock (Canguilhem, 1991). God is not a mathematician (Jonas, 2001). The pieces of the puzzle seldom fit, and yet life goes on.

The study of the human mind by the human mind is absolutely fascinating (Spira, 2017). We dive into a multitude of universes that, on occasions, intersect. Thus, as 21st century neuroscientists (and, for that matter, biologists, and I may even data to say physicists), we are faced with the following challenge: to cultivate a scientific mind that does not preclude its own participation (Skolimowski, 1994).

Quo vadis biology? I believe that the foundations of a new science of life and mind should be *explicitly* grounded in the felt presence of immediate experience. How will such science look like? How shall one practice it? It is early to tell. A first step, however, would be not only to acknowledge that situation matters, but also to cherish its primacy (Bitbol, 2002). Knowing is given in our experience. Human experience is actually the very condition of possibility of scientific knowledge. In a sense, science is nested in the humanities.

As scientists, when we talk about what we know (and even about what we know we do not know), we may lose sight of what we cannot see (or perhaps do not want to see). We do not see that we see. Even more, we do not see that we do not see that our seeing is never a viewless view. This is our blind spot.

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