

* Original article

On the persuasion power of medical images

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Abstract

The article aims to analyze the persuasiveness of medical images using as examples two specific cases: the use of mental picture of European medicine in the late nineteenth century, and of neuroimaging in the field of contemporary neuroscience. The commonality between the two cases studied is the power of convincing portrayal of the supposed reality of behaviors or pathological conditions, especially in the field of mental medicine. We will emphasize the field of neuroimaging, mapping a critical analysis of the peculiarities of its production process, particularly by researchers in the neurosciences.

Keywords: medical images; objectivity, neuroimages.

Introduction

Nowadays, the way each of us get easy access, through magazines and other media, the images of muscles, bones, functional systems of the body, prosthesis, transplants, ovule, nerves, brain functioning, unveil and demystify much of what until recently was mysterious and unfathomable - what happens under our skin, in the invisible space of our visceral.

The use of instruments that allow the scrutiny of the inner body is a sine qua non for those explorations. Reiser (1990, 1993), for example, analyzes the emergence, throughout the century XIX, of various other devices such as the ophthalmoscope (1851), the laryngoscope (1857) and later the X-ray (1895), which allowed the visual exploration of the inner side of the body without surgical penetration.

In this article, we will focus specifically on two episodes of the medical history related to the field of images: the use of photographs of European mental medicine in the late nineteenth century, and of neuroimaging, in the field of contemporary neuroscience. We will emphasize the field of neuroimaging, mapping a critical analysis of the peculiarities of its production process. The commonality between the two cases studied is the convincing power of the supposed portrayal of behaviors or pathological conditions, especially in the field of mental medicine.

To reconstruct some of the ways of this passion for visualization in the history of Western medicine requires at least one scenic retreat to what was one of its conditions of possibility - the publication in 1543, of the book by Andreas Vesalius [1514-1564], *The Organization of the Human Body (De humani corporis fabrica)*, which is the sign of birth of modern scientific anatomy. In this work, the authority of the medical propositions of Galen [129-200] has been challenged, since Vesalius inverted the hierarchy of textual authority and empirical evidence, giving dignity to the findings produced by the experimental observation of the body, under the anatomical view (Ortega, 2008). The new ideas that the work of Vesalius predicted - which authorized the knowledge of the body from the dissection of corpses, has become a precondition for Western medicine since then: the "truth" of the disease would be found inside the body. Thus, the drawings by the author in the quoted work marked a period of great development in the history of anatomy and in the anatomical illustrations. Ultimately, his book sums up the idea that the truth of the diseases would not be in the words of Galenic writings, but in the images produced by the dissection and knowledge of cadavers. Since then, it could be situated a close relationship between the visual and scientific knowledge of the human body, bringing as a consequence the model of a single body presented as the norm for all of them.

The reduction of body experience subjective to an objective, measurable, quantifiable and fragmented body since the vesaliana revolution follows the history of anatomical practice and visualization technologies, corresponds to an objectified relationship with the body. It is in this context - as instruments which aim the production of objectivity in medical science - that we will

understand the medical imaging and the machines which produce them.

Transparent bodies?

In this matter, it seemed interesting to follow the analysis of van Djick (2005), who is interested in understanding the role of medical visualization technologies in social and cultural construction of illness, according to the ideal of a transparent body. This ideal is a construct at the interface among medical instruments, media technologies, artistic conventions and social norms, and reflects notions of rationality and progress sustained by biomedical aspirations. Van Djick (2005) draws attention to the fact that the idea of a transparent body, which would give access to its hidden corners, is contradictory. If the body has become more visible in its interior, it has also become technologically more complex, because the more it is seen through lenses and different parameters, more complicated the achieved visual information becomes and, therefore, the object seen itself. In the case of brain imaging technologies discussed here, they bring undoubted clinical insights, but ultimately confront physicians and patients with troubling dilemmas for which there are still no answers.

The myth of transparency lays on two postulates: that to see is to cure, and that look inside the body is an innocent activity and without consequences. The look is apparently defenseless because it keeps the body unharmed when only it reaches them. Through these images, it is supposed that it is possible to reveal the interior of the body in a realistic and almost photographic manner, in which each new instrument produces more accurate pictures of the pathologies which are underneath the skin. Nevertheless, according to the author, the body technologically viewed is everything but transparent, as its complexity was also heated by the methods that made it more visible. What can be concluded, therefore, is that a body unveiled does not mean more accessible for understanding by lay.

Since the fifteenth century, several technologies have been produced to allow access to the interior of the body, and more than a way of revealing in a supposedly realistic manner our inner side, these technologies have affected our views on the bodies, the ways we look at the process of health and disease and the very our idea of what must be therapeutic intervention. Having become part of modern life, medical images assumed a self-evident and causally relationship with the disease. Therefore, unconditional confidence in the mechanical eye of the machines has direct consequences - on patient care - and indirect - on health policies built from there.

The common belief in the progress of medical science lays in part on that firm confidence in the mechanical eye: improved imaging instruments will lead to more knowledge, resulting in more cures. From the preview of the diagnosis, we have, in theory, a small step for what was postulated in being only necessary to look to find a medicine for the illness whereas each new technique seems to reveal some secret of human physiology (soul?). In short, while the machines made the inner side of the body seemingly transparent, the images they produced, in contrast, did not simplify the universe of the health. To see eventually leads to difficult choices, moral dilemmas and multifactorial scenarios.

The presupposition that seeing is the first step to healing comes from the idea that if we see nothing - or if the machines do not see anything - nothing is happening. The definition and recognition of a disease often depend, therefore, on the ability of medical machines to provide objective visual evidence, and insurance companies may not cover the costs of illnesses that are not visually substantiated or materialized somehow. The role of visualization in the social and cultural construction of disease points to a process in which, according to van Djick (2005), is able to detect a virus on its site of action is equivalent to having access to arms to fight the invaders. This is the eagerness to prove the existence of which was considered immaterial so far or to attest to the materiality of what until now was not possible to be seen.

Photographies in mental medicine in the XIX century – the Salpêtrière case

In the medical field, photography seemed to offer an effective mechanism to contain the subjectivity and consequently the production of objectivity. The neutral and objective eye of the camera, supposedly corrected the subjective mistakes of medical illustrations, which were handmade (Daston, 1999; Reiser, 1990). By the early twentieth century, photography became a powerful force, a symbol of objective truth.

We will dedicate ourselves to understand specifically the visualization case in in the field of mental European medicine in the nineteenth century, especially in neurology field at that time. This is because the nineteenth-century neurology was a field particularly accustomed to image record of bodies out of control, as it is well attested the visual material produced by Charcot at Salpêtrière

Hospital in the late nineteenth century (Cartwright, 1995; Didi-Huberman, 1984). In it, we have a compilation of photographs of cases, mostly of hysteria in different phases of hysterical attack. It is important to consider the use that neurology makes of the records of photographs of patients is contextualized in a dilemma of the neurological field - the difficulty of finding convincing anatomical and physiological findings for the pathologies it treated, as was the emblematic case of hysteria².

The fact that hysterical symptoms could be undone by hypnosis was doubtless a problem for the legitimacy of the neuroanatomical perspective of Charcot and his recognition by his peers. The idea that this disease is based on a functional lesion was an important solution to this logical problem. A dynamic or functional lesion meant for Charcot (1888), that it could not find any change in the tissue in post-mortem examination. It would be an organic event not related to a change in the structure of tissues or organs, but only for its functioning. Moreover, the assertion of laws and rules present in the hysterical pictures, similar to other neurological disorders, contributed decisively to the construction of objectivity for hysteria.

The photographic demonstration of the different periods of the hysterics attack, and its laws and regularities, as well as the stigmas and symptoms of major emphasis, aimed to establish a stable and well described symptomatology, which could serve to identify the stigmas, and could make a differential diagnosis. This allowed Charcot to get away from criticism that was addressed to him, especially, the French neurologist Hyppolite Bernheim [1837-1919], on the illegitimacy of hysterical symptoms (Castel, 1998). Photographs supplied the absence of hysteria anatomopathologic findings, acting as possible evidence given the lack of an anatomic substrate of the disease. In this paradigmatic case, the photo had value as evidence by itself, with power of persuasion on observers, making visible the mark of the pathological manifestation, and its nosological existence. In the absence of an anatomic substrate, the photographic lens would capture the truth of hysterical symptoms as a clinical entity circumscribed, scientifically endorsing the description of hysteria, despite the absence of structural damage that characterized it (Didi-Huberman, 1984).

The volumes of the Photographic Iconography of Salpêtrière, compiled mainly by Doctor Desire Magloire Bourneville [1840-1909] and by the photographer Paul Regnard [1850-1927], between 1877 and 1880 are therefore an example of the production process of truth and clinical fact of the nineteenth-century French psychiatry history. The photographs constituted a crucial element in the operation performed by Charcot of granting legitimacy to the picture of hysteria. Therefore, the photograph offered a new technique for the postures figuration, used to enhance the clinical knowledge of diseases and they are, in the visual domain, equivalent to an authentic document. It could reveal the unseen, taking a role as irrefutable evidence (Langlois, 1994).

Efforts in the history of medicine to give objectivity to the remarkable unspecificity of some mental illness were driven by the wave of innovations and brain imaging studies to which we were led today. If at the turn of the nineteenth century, Charcot called the photos to give solidity to the elusive field of neurosis, the end of the twentieth saw an explosion of new techniques whose objectives may not deviate much from that of Charcot: to provide visual evidence - almost as a synonym of materiality and objectivity - to the clinical entities belonging to the field of mental illness at the beginning of the twenty-first century.

The development of the field of visualization techniques of mental illness should be related mainly to advances in brain imaging. This field has a trigger point especially in the 1950s and 1960s, when researchers began using computed tomography scans - which culminated in the 1970s - in the clinical use of these technologies. A few decades before that, one of the main methods for studying the connection between brain and behavior was indirect, through examination of individual injured brain, in order to assess how these injuries affected the daily performance (Crease, 1993).

In the specific case of brain visualization, x-rays did not promote so many advances, because the nervous tissue has low opacity and it is placed in the bone box. Many developments were necessary to transcend the x-rays and get a more accurate depiction of the brain. Certainly, the development of computers together with imaging technologies were an important step in this process, since it was possible to perform mathematical calculations with the measurements achieved by processing the collected information. It is in this context that technologies are developed such as positron emission tomography (positron emission tomography-PET) and magnetic resonance imaging (magnetic resonance imaging - MRI), functional or not.

Brain images

It is noteworthy the increasing number of studies using functional magnetic resonance accessible to the general domain, crossing the boundary between the scientific and lay public, by presentations of brain imaging in color scales. The images produced by the body imaging technologies have occupied

a significant place in the cultural imagination, which associates reality with the physical body, to scientific progress and to the legitimate and authorized knowledge (Roskies, 2008; Joyce, 2005). These technologies have been enthusiastically well-come, not only by the scientific community, but also by lay people, who have access to them by the popular media.

However, the persuasive appeal of these images is indirectly proportional to the resources of its observers to criticize its production process, which easily unfolds into an uncritical embrace of any allegations that are made ??through them. The range of these technologies are oversized, while its limits are hidden.

It is important to note that the enchantment and the effect of truth that these images produce only makes sense in a culture in which the brain and its functions have been given great power of persuasion in the explanation of diseases, behaviors and tastes. Ehrenberg (2004), Vidal (2005), Ortega and Vidal (2007) call "cerebral subject", the processes, practices, speeches, ways of thinking about health and disease, taking as basis the idea that the brain is the organ only needed to build our healthy or sick identity.

That brain is an organ necessary for the development of vital functions and exercise of human capabilities, no one would ever contest. However, what is worthy of criticism is that the particularities of its operations are considered sufficient for the formation of certain features of human action: moral choices, mental illness, sexual practices, among others. The use of neuroimaging is one of the most important branches in the development of works which aim at establishing neural correlates of human experiences, behaviors and diseases. It is within this context that the brain images have been placed - as a new imagery vogue, to produce correlations between brain patterns and human behavior.

The wave of innovation on the studies of brain visualization in which we were led today, has its trigger point in the 1950s and 1960s, when researchers learned to do computed tomography scans, which was converted into clinical use (Crease, 1993). The basic concept for the technologies of brain imaging such as functional magnetic resonance imaging and positron emission tomography, is that a change in regional blood flow may reflect the neural activity. Requested tasks or forms of stimulation would induce synaptic and electrical activity in certain brain regions, which would shoot changes in metabolic processes and hemodynamic responses including cerebral blood flow. The techniques of brain imaging allow detecting these changes in vascular parameters (Kim, 2003). Unlike a map, a table or a graph, neuroimaging gives the impression of transparency, and that the object is directly accessed and represented (Crease, 1993; Dumit, 2004). This knowledge encourages acting from familiarity perceived with the object being viewed.

We are interested in understanding this appeal that brain imaging bring with them, which gives them the place of truth on the disease and on the individual affected by it, being a technological mean in which the disease is supposedly shown. The visualization of the disease is the point that equates objectivity of the method to organicity of the lesion (deficit or altered neurochemical pattern), or in other words: what is visible by objective means and scientifically approved is a sign of the existence of the disease, and of its legitimacy.

If researchers were interested only in statistical measures, the brain visually represented would be totally superfluous, and mathematical data and comparisons among different brains would be sufficient. But the visual representation of the brain improves the visibility of what were only numbers and comparisons before. "The technique of functional magnetic resonance, thus makes visible and space what is otherwise, invisible and temporal " (ALAC, 2004, p.203). Therefore, there is a co-dependency between the quantitative manner and the visual-spatial manner of representation associated with the fact that functional magnetic resonance images materialize these two aspects at one time only.

The anthropologist Joseph Dumit (2003) is engaged in analyzing the role of brain images in the media and its persuasive power in the formation of what people think of their own bodies and themselves, wondering how we see in in brain imaging ideas about who we are and on our illnesses, especially mental illness. What intrigues the author is the process by which such works will slowly helping to produce in the person who is visualizing, the feeling that the brain which is being seen belongs to the person itself.

Therefore, he proposes to investigate the impact of brain imaging produced mainly by PET scanners from 1970 - since this was the first non-invasive technology to allow access to regional processes of the brain. It is from this relationship between the identity of the one who has the visualized brain and brain imaging that Dumit (2004) describes the formation of the belief in the existence of sick, healthy, intelligent, depressed, obsessive types of brain.

In this context, the images of brain types, by the inevitable call to "showing what exists", are taken as unquestionable facts, and have contributed to the categorization of individuals from their brains. The presentation of images of typical brains of schizophrenic, depressed or normal patients produces the feeling that there is a categorical difference among three types of humans who correspond, essentially, to their types of brains⁴.

In this same direction are the arguments of Alac (2004), who examines the process of producing knowledge and objectivity underlying procedures for submission, review and publication of experimental research work in cognitive science, and the specific role of visual representations of the brain in the production of a scientific fact. The colors used in images are generally divided into those that represent the background of brain (serving simply as a contrast with the interest studied areas), and the rest is black; the structural images of the cortex, in turn, represent what is static, and they help situate what is of interest, appearing in shades of gray, and maps of activity patterns activity specifically in the studied areas, appear in bright colors, representing the cognitive activity that should be the attention focus of the viewer. The color manner of the images leads the attention of their viewers to certain portions of the image with some particular significance. The visual representation is constructed, so as to exclude non-target interpretations by the author.

In this process of transformation of numerical data into visual data, what is invisible or, at most, visible by graphs - the numbers and statistical comparisons - is transformed into visual data, which can be experienced. Interestingly, however, that the brain images are not photographs of a real brain (Alac, 2004; Roskies, 2008; De Rijcke and Beaulieu, 2007), but the visual reconstitution of mathematical and statistical parameters - so, they are images of numbers and not of brains.

The processes that support the review and publication of scientific papers are easily ignored if we suppose that they are from a world neutral of experimental procedures. But what is seen is that the strategies of choice of images to be published in journals of this field depict the expectation that certain areas of brain activation - which has the habit of finding in the literature on functional magnetic resonance imaging - appear more visible than others. As stated (ALAC, 2004, p.212): "As this transaction demonstrates the number of points of cortical activation, the link between the image and its referent is always mediated by the filters rules and social and cultural expectations". The vision of reality becomes clearer, less confused and easier to see when the parameters of the scientific culture of which it belongs are followed.

Beaulieu (2001), emphasizes that the essence of diseases, behaviors or mental functions depicted by brain imaging consists of the synthesis of the lesions identified by automated processes among the cases, not by the observation of individual cases. For the author, this process contributes to essentialist notions of disease, which become possible when relevant differences among the brains are identified by the development of digitally standardized comparison parameters.

The ideals pursued by these methods are, therefore, to remove the individual, both as idiosyncratically sick (inasmuch as the pattern of disease is from compared samples) or as subjective, by automated manipulation of data. This approach produces brain models based on cleansed data, which underwent changes in order to produce an ideal goal - a median "normal" brain and a sick brain. It is the revelation of the phenomenon of disease among the examples, and identification of a particular case (deviation) among large amounts of data.

Another important point to be detailed in the production of these images is that the significance of a particular brain function involved in an activity is commonly defined by regional differences in activation between two brain sets. In each case, the emphasis is on determining which voxels⁵ of activity sufficient differ between the two brain wholes to suggest that anatomical location of these voxels is involved in the comparison process. The change in activation is significant and represents the participation of the differentially activated area in the investigated task. The greater the activation, the greater is the participation of that area in a given function.

The idea underlying the reading of the images is that voxels do not differ between the two brain sets which are not involved in the researched task. However, in the living brain, all areas are constantly active, except those that are dead because of an injury, for example. When the images are colorful, voxels that are different from each other get colors and the other voxels are often left black (Dumit, 2004). There is an effect generated by this mechanism that is the impression that no other area, except the colorful ones, is active - which is not true. This only reinforces the idea that the others are not involved in the process, since they do not appear colorful in the brain photograph, postulating that the brain regions which do not show global change in its activity are not directly involved in the task or researched condition.

Once the data are converted to images, the researchers begin to decide which images to publish. In

this process, the most extreme images are the chosen to show the differences which are intended to report. Extreme images are those who present a greater difference in relation to another, and that, by assumption, can better represent the significance of the experiment. In articles published with brain images in scientific journals, appear, in general, two very disparate images appear - which, in theory, would offer a clear difference for diagnostic discrimination, even when the article text explicitly warns against this kind of explanation. The choice of extreme images even when the distributions between studied groups are not so clear is a standard practice in neuroimaging research community. As images of extreme differentiation, they provide a visual sense of a clear distinction between normal brain and that subject of the research, although there are many schizophrenics, as exemplified by Dumit (2004), whose brains resemble those considered healthy and vice versa. The picture, however, labels and shows the disease itself, and the objectified patient.

Another uncertainty with which those who deal with the interpretation of the images they encounter is the presence in the resulting images, of what is called UBO's (unidentified bright objects) in radiology. Bright spots in the images, whose clinical unfolding can explain little or almost nothing so far.

Among the many lines that make up the use of these technologies, it is also important to highlight that researchers almost exclusively conduct their studies with small samples (from 40 to 20 people), and the details of the experiments are often left behind, leaving from them no more than two images with ideal standards, such as "depressed person" and "normal control", which unite a brain abnormality to a diagnosis (Dumit, 2003). The risk of such practices is a separation between these images and the context that accompanies them, which contributes for them serving as an argument for the existence of a definite difference from a brain type to another. Another consequence is that patients see themselves as someone who shares, in addition to a suffering, a cerebral type with others.

Conclusions

The care needed for the use of neuroimaging does not deprive them of the usefulness as a tool for investigating the nature of brain processes. But, in addition to the construction of electrochemical patterns which a disease can associate to, they serve for the construction of convergent and divergent evidence on the phenomena under study. Perhaps we are addressing to the technologies of imaging of the brain more questions than they can answer - mainly because they are still preliminary conclusions that can be reached from the finding that an area is more active than another in a given task. It is important to be armed with questions that allow us to take advantage of these techniques - this is a necessary precaution for not making its use a manner of simplifying complex issues, which depend on variables not covered in what the brain visualization provides (Kosslyn, 1999).

The finding that an area is activated, even an area with well defined characteristics, is not sufficient to infer anything besides the fact that the properties of that area contribute to the performance in matter (brain function, behavior, pathology, among others). Therefore, "to verify that certain brain areas are active when someone performs a task is not enough" (Kosslyn, 1999, p.1293). Such data are only interpretable in the context of theories that lead to specific hypotheses. It is these theories that it is necessary to make use of to interpret them, not to the images, *per se*

Although we tend to interpret neuroimaging as if they were photographs, unlike these latter, the brain images are not self-evident nor self-explanatory. They only make sense within a culture of shared meanings. (From Rijcke and Beaulieu, 2007). In other words, the epistemic status of neuroimaging can not be equated with the photographs, since the former are generated by methods entirely different from the latter. The resulting images of functional neuroimaging do not allow us to see directly the properties of the brain, but to visualize non-visual properties determined by the object that the researcher is trying to understand - the changes in blood flow resulting from carrying out certain tasks. It is inferred from that signal dependent on blood flow that neural activity has changed (Roskies, 2008).

It is the prior knowledge that allows us to see in numbers and statistical correlations, a representation of the brain functioning and at the limit, a narrative on human behavior. It is the social interaction at its different levels which constructs fields of attention on which the interpretation of brain imaging are supported (Roepstorff, 2007). Furthermore, without taking into account the limitations of the techniques, i.e., what they cannot answer, the inferences drawn from them can lead to a hyperbolic interpretation of their findings (Burock; 2009).

The brain images tend to function as a demonstrative proof of a definitive biological marker for the disease, as an objective criterion for its definition, or as evidence that can connect to a pathology. In the case of several controversial conditions currently studied, the brain images produced are still very

uncertain, made ??from preliminary studies, full of UBO's (unidentified bright objects) on which little can be explained. However, they are iconically used as evidence of the neurobiological nature, and even as demonstration of the cause of certain pathological conditions⁷. The migration of these results - from this research field still in its beginning - for the diagnosis and construction of new categories of disease could be a consequence of that persuasiveness power of brain imaging, which is not found in other diagnostic tests. But, we must resume the questioning of Kosslyn (1999): Are we addressing to neuroimaging questions they can answer?

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Notes

It is not discussed here the emergence of the X-ray machine – which was created in 1895 by German physicist Wilhelm Roentgen [1845-1895] – and its cultural impact, although the ideal of a transparent body had in it its foundation stone (Kevles, 1998).

2 Hysteria, as it appears in the writings of Charcot (1888) was considered a functional disease of the nervous system that brought as a consequence sensory symptoms, including chronic pain and visual disturbances, hemianestesia, headaches, seizures and motor crisis. For a more detailed brief historical study of hysteria as a medical category, we recommend the works of Trillat (1991) and Micale (1989).

3 It is important to consider that, in addition to image the brain, visualization technologies are used to portray other body parts, or even the brain itself in its structural features. These uses are not the theme of questioning of Dumit (2004), since in them, the image can be calibrated directly with its referent. But in the case of brain activity to human behavior, mental illness and certain higher functions, there is no corresponding calibration.

4 It is without reason that many social movements in health field in contemporary society, particularly those developed by the Internet, are engaged in disputes over the moral and legal recognition of their pathological conditions through this apparent new found of physical evidence which is brain imaging. This is the case of people with schizophrenia, attention deficit disorder and hyperactivity, chronic fatigue syndrome – each one in its own way, seeking to legitimize their conditions by combining the resources of an emerging science with the claim of physicality, an attempt to construct their clinical condition as something tangible and physically existing (Cohn, 2004).

5 A voxel is the basic unit of the CT scan, represented as a pixel in the image. It is the smallest distinguishable part in a three-dimensional image.

6 Stewart (2002) draws attention to the fact that many neuroscientists dedicated to the field of neuroimaging ignore the plasticity of the brain and multitasking capabilities of this organ in favor of a concept that links the brain to perform tasks confined to specific parts. It is as if the trends of neuroscientific research works happened in the opposite of the assumption of brain plasticity, assuming that a functional change is caused by an injury and nothing more, and simplifying assumptions of the function and location of its constancy.

7 It is within this context of criticism to hyperbolic interpretations of the results of works with neuroimaging, particularly functional type, which some researchers call attention to the plight of rigor in the works. These critical studies indicate that research using functional magnetic resonance to investigate emotions, personality traits and social cognition have high statistical correlation between brain activation and measures. These correlations are much larger than can be expected, because of the limited reliability of both the technical functional resonance and measures of personality or other complex human functions. In this regard, check Vul et al. (2009).