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From concepts to images: visual representations of science in museums

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This paper aims to discuss how visual elements (still and moving images) are used and what purposes they serve in scientific museums. It focuses on scientific museums but it is a based on a broad definition of science, which encompasses traditional science museums and science centres, natural history museums, museums of archaeology and ethnography. A scientific museum is considered so when it shows the results or the processes of scientific research, be it in the natural or in the social sciences. Diverse kinds of images will be under analysis: photography, scientific illustration, video recording, computer-generated images, diagrams, graphics and drawings.

The supporting information for this paper was gathered predominantly through content analysis of exhibitions in Portuguese museums, as part of an ongoing research for a PhD dissertation[1]. However, the conclusions reached through this work can hardly be country-specific, since museum practices in Portugal are strongly influenced by international trends, particularly those from other European countries.

Considering that science has a strong abstract component (the construction of theories, concepts, hypothesis) and is expressed mainly in mathematical formulae and written words (reports, articles in journals, books), the visual dimension hardly ever comes into play. However, it can be an essential aid in translating scientific knowledge to a lay public in the museum medium.

Unlike most art museums (in particular those specialising in painting, photography and video art), scientific museums tend to rely heavily on three-dimensional objects (scientific instruments, interactive devices, taxidermised animals, archaeological or ethnographical artefacts) and to be quite text-intensive (labels, written panels, instructions for operating interactive devices).

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However, images are increasingly being used in scientific museums. Though in some cases their purpose seems to go little beyond generating an appeal among visual media-saturated audiences, they can serve several functions and they can relate in different ways to the artifactual and textual contents of the exhibitions.

From the analysis of several dozens exhibitions in almost as many museums, three main functions have been derived:

- to convey knowledge
- to place artefacts in a certain context (historical, cultural, geographical)
- to generate a certain response in the public.

These are but some of the roles images may play in museums, and they are far from mutually exclusive: the same picture can be used for different purposes at the same time.

Conveying knowledge

Although museums do play several roles in society (leisure, entertainment, tourism, showcases for institutions, business companies, local authorities), in scientific museums by far the most important role is education (Lawrence, 1990, p. 108-109; Davallon, 2003, p. 183; Bloom, 1998), even though it is debated whether museums can teach science or merely stimulate an interest in it (Yahya, 1996; Gregory and Miller, 1998, p. 213; Butler, 1992, p. 106): "the consensus seems to be that there is very little evidence of learning among casual visitors to exhibitions (…) There is however a wider claim to be made for exhibitions as promoters of public understanding. If properly designed, they can serve to awaken interest in science" (Miles and Tout, 1998, p. 28).

Accordingly, most of the images used in exhibitions intend to transmit some knowledge, to impart information, to teach the public about the subject in hand.

In some cases, the picture is the exhibit itself, like the drawings that show optical illusions, which are quite frequently used in science centres. (Slide 2 – Optical illusion, Pavilhão do Conhecimento, Lisbon). These drawings illustrate how the brain selects and reconstitutes information from ambiguous visual signs.

Some exhibitions show images of living organisms, cells or human body organs obtained through photography or through scientific instruments such as the electronic microscope, magnetic resonance or CAT scans (Slide 3 – Cerebral X-Ray taken by Egas Moniz, Museu da Medicina; magnified drosophilae fly, exhibition about insects, Pavilhão do Conhecimento). This serves the purpose of both showing the public what these things, which are invisible to naked eye, look like and to demonstrate how science gathers information about them.

Scientific imaging stands for scientific truth and proof. According to Daston, the use of photography in science, namely in biology, has become in the end of the 19th century, a warrant for "mechanical objectivity", considered far superior to scientific illustration, since it required little human intervention: "a symbol, if not of accuracy, at least of authenticity. It was photography's immediacy, its automacy, in which nature seamed to represent itself without human mediation, that recommended it to the scientists, tormented by the fear of the worst traits of their 'self'. 'Untouched by human hands' was the litany of these 'mechanical images' (…) Like in all forms of objectivity, the main purpose was not truth nor certainty, but rather freedom from any kind of subjectivity, in this case the subjectivity brought upon by interpretation and projection" (1999, p. 90).

Charts, diagrams and models are commonly used in scientific literature (books, articles in journals, posters in conferences) as a visual representation/reconstitution of a natural phenomenon that has been observed, to illustrate a hypothesis or the data that corroborates it. It is a sometimes quite complex and highly codified way to communicate information among scientists. In order to decipher these images, a specific kind of literacy is required, some scientific training, a knowledge of terms such as legend, scale, symbols, x and y variables, axis. For Latour (1995, p. 116-117), these images present to the reader of a scientific text what he is being asked to believe, the pictures show what the text is saying, but they are not transparent to all readers, even specialists, since they have to be at least slightly familiar with the instruments and procedures that have produced the pictures. According to Lynch and McNally (1999), both observations and their representations are cultural artefacts, created by individuals and groups with particular interests, permeated with theory and concepts, intelligible only to a specialized community and mediated through persuasion and rhetoric as sources for agreement between the observers and their public.

This type of image is also commonly found in scientific museums, sometimes constituting what is called a "three-dimensional book" kind of exhibition (Hall, 1987, p. 165; Rosnay, 1998, p. 23; Verdere, 1988, p. 105). It is aimed at specific segments of the audience, more specialized, and often attracts very little attention from the lay public. (Slide 4 – Atomic structure model of Scheelite, shown alongside mineralogical specimens, at the exhibition "Minerals, identify, classify", MNHN Lisbon; Slide 5 – geological diagrams and maps, Museu do Ferro e da Região de Moncorvo). However, apart from the information contained in them, these images also convey to the public a certain representation of science, as something esoteric and complex but also firmly anchored in facts and data.

However, some models and diagrams in museums are designed specifically to be understood by the lay public, using simple terms and bright colours (for instance, the internal workings of a machine).

These graphics, diagrams and models can be presented both in a static two-dimensional format (as pictures in panels) and in computer-generated images, which can be animated, shown from different perspectives and interactive. These are frequently used in exhibitions about mathematics, especially geometry (Slide 6 – photos from the exhibition "Symmetry, game of mirrors", produced by Atractor), and about biology, for instance to show intracellular processes (Slide 6 – images from the exhibition "Hands that share life", Museu de Ciência UL).

Most objects in museums have lost their utilitarian function; they are to be looked at but not used (Pomian, 1987, p. 16; Pearce, 1992, p. 33). In ethnographic and archaeological exhibitions, images are frequently used to show "us" how the artefacts on display were used or manufactured by "others". Both these disciplines study human societies, in all their diversity and complexity (customs, beliefs, practices, values, ways of life, economy, political organization, arts, etc.), and material culture, embodied in artefacts, cannot represent but a very small part of these societies. These artefacts, manufactured by other cultures, distant in time or space, can also be very unfamiliar (Hall, 1987, p. 215, p. 226). Photos and drawings are important means to shed some more light on these societies and to impart more information gathered by the researchers. Static objects come to life and become more recognizable when shown in the hands of human subjects, being manipulated for specific purposes. (Slide 7 – fishing apparatus next to photos of boats and fishermen in Rio Douro, Museu do Douro; Slide 8 – illustration of a roman sculpture workshop, with carved stones and carving tools, Museu Monográfico de Conimbriga).

In ethnographic exhibitions, such images usually assume the format of photos and even films, with sound and movement, demonstrations and oral testimonies, whereas in archaeological exhibitions drawings or murals are predominant (Verarde, 1988, p. 99). Displaying archaeology requires different strategies, since "what we know of the past depends partly on what survives into the present and partly on how we interpret it" (Durrans, 1990, p. 145). For Coubourd (2003, p. 157), an attractive but scientifically correct museology in archaeology has to strike a balance between known facts and plausible interpretation. Especially in pre-historic archaeology, objects survive several selection processes: by the people who manufactured and used them (some objects are conserved, some are destroyed), by nature (some materials are more degradable than others), by archaeologists themselves (whose methods of collection and observation may favour some objects over others). They cannot be wholly representative of the human culture from which they emerge, they have to be interpreted and that interpretation is frequently open to

debate (Hall, 1987, p. 216): “in being mindful of ideology and its influence on people, archaeology recognises today’s observations are as much a construct of today’s context in terms of bias and belief as they are true products of the past” (Crowther, 1989, p. 39). Archaeological illustrations draw on a knowledge that surpasses the objects, are sustained by known facts but also subjective projections, their popularity and credibility are more based on artistic merit than scientific authority (Coubourd, 2003, p. 165-166).

Thus, images can also be used to reconstitute wholes from which only material fragments subsist. Such is the case of archaeological sites, that can be virtually reconstituted to show how the original buildings and structures would have looked like, based on information gathered by the archaeologists and “educated guesses” (Slide 9 – ruins of roman theatre and computer aided design, Museu do Teatro Romano, Lisbon). Another example are palaeontological illustrations, that represent complete skeletons or full-bodied dinosaurs, based on often partial fossilized remains (Slide 10 – illustrations from the international competition held annually by the Museu da Lourinhã). These pictures draw heavily on other forms of evidence collected by the scientists, as well as on theories and hypothesis, and help visitors to make sense of vestiges that are sometimes quite obscure in themselves.

Embedding objects

Objects in museums have been displaced from their contexts or origin and placed in a new context, where they acquire new meanings (Smith, 1989, p. 6; Silverstone, 1998, p. 35) “the context of the museum display is quite different from the one for which it [the object] was originally made, both historically and functionally” (Morton, 1990, p. 134). However, the objects in museums intend to represent the context from which they were removed, they have a documental value: “in a museological context the object reflects one or several manifestations of its changeable primary context” (Mareovic, 1995, p. 25).

Images can help reconstitute the context from which the objects were removed; they can embed isolated artefacts in its original historical, cultural, spatial environment.

Whereas science centres tend to “take scientific principles out of both the natural and social worlds” (Gregory and Miller, 1998, p. 208) and to ignore the historical and social context, museums dedicated to the history of science are “concentrated on the historical study of scientific artefacts in all its facets: antiquarian connoisseurship, the development of small-scale precision technology, the structure of the instrument making trade and scientific questions such as the relationship of instruments to experiments and the development of scientific concepts”

(Hackmann, 1998, p. 66). This type of science museums (most frequently dedicated to the exact and natural sciences) usually anchors scientific instruments or even interactive devices, through photographs or drawings (engravings), in a contextual framework, that can highlight several different aspects:

- the scientists who have used the instruments (Slide 11 – instruments for measuring radioactivity, next to photos of Marie Curie and two of her Portuguese disciples, MCUL);
- the laboratories or scientific institutes where the instruments or equipment were used (Slide 11 – Van de Graaff accelerator, next to several photos of the National Technological Institute and Nuclear Physics and Engineering Laboratory, MCUL);
- historical experiments, when a scientific principle was first discovered or tested (Slide 12 – interactive device using the Magdeburg hemispheres to demonstrate atmospheric pressure and void, next to a tile panel representing the Magdeburg experiment, in 1654, MCUL);
- practical applications of a scientific principle, either in technological product on in everyday activities (Slide 13 – interactive device demonstrating the principle of angular movement next to a reproduction of a Degas painting representing a ballerina, because dancers use this principle when they open their arms wide to reduce the speed of spinning).

Though the original object has a unique iconic value (Pearce, 1992, p. 24; Schaffer, 2000; Swade, 2000; Simmons, 1996, p. 83) in some cases it can be replaced by a visual representation, in the interest of the message that is being conveyed. That occurs, for instance, with very rare or one-of-a-kind scientific instruments (like Hooke's microscope from the collection of the Science Museum) that can be shown through replicas or photographs of the originals in museums dedicated to the history of science. Or very large and complex scientific equipment, for instance CERN's Large Hadron Collider. One other example may be the use of photos of iconic objects to mark certain dates or periods in a chronological panel (for example, Tutankhamon's mask to symbolise the imperial period in Egypt).

Images as embedding devices are also used in other kinds of museums. Museology manuals frequently recommend the use of enlarged black and white (or colour) photos as background for showcases (Hall, 1987, p. 100; Velarde, 1988, p. 96)

Though in ethnographical exhibitions the photos usually represent some kind of activity and bear a direct relation to the artefacts next to them (as seen above), some photos are used just to give ambience, to evoke a geographical location or a cultural group (Hall, 1987, p. 226). In this case (Slide 14 – African room at the Museu Municipal Dr. Santos Rocha, Figueira da Foz), this is a

local museum which has an assorted collection of African objects, brought in the early 20th century by sailors, merchants, military personnel and travellers, which used to be exhibited in a "comparison" room, next to archaeological artefacts. Thus the objects were not collected in the course of anthropological fieldwork and very little is known about them. The photos at the background of the showcase were chosen because they represent African scenes, they do not necessarily match the objects nor even the peoples that manufactured and used them. It is a rather stereotypical and a-historical representation of the "other" (Riegel, 1998, p. 88), hugely dissociated from current debates in academic anthropology.

Archaeological and ethnographical museums can also highlight the history of their collections by showing photographs or portraits of illustrious archaeologists and anthropologists that gathered them.

In archaeological exhibitions is also quite common to find photographs of the archaeological sites from which the artefacts were recovered (Slide 15 – ceramic fragments next to an enlarged photo of a burial ground where they were found, Museu de Montemor-o-Novo). Though many archaeological sites can be visited and sometimes have interpretation centres (a specific kind of museum), most archaeological findings cannot be left *in situ* so they have to displaced to museums. These photos can help to bring the site into the museum or to restore symbolically the objects to their place of origin.

Persuading the public

Finally, the museum is far from a neutral ground where science is displayed: "the museum is a medium which conveys messages explicitly and implicitly (…) a medium which lends itself to imparting certain views of science and technology and to being part of the process of socially constructing these in a particular way" (Morton, 1990, p. 130). These views of science and technology are of course positive: "their collections and their exhibitions are considered potential resources to instruct the public on the beauty, the importance and the value of scientific research" (Lewenstein and Allison-Bunnell, 1998, p. 159). Museums aim to promote a certain social status for science, they are part of the process of social affirmation of scientists as professionals that produce useful and authoritative knowledge: "science is presented by museums as a certain knowledge, arrived at through painstaking, objective research" (Butler, 1992, p. 112; Gregory and Miller, 1998, p. 207), "scientists want to educate the public about the fundamentals of their fields. They want museums to explain the processes through which science creates and learns. They want to celebrate the achievements, both historical and contemporary of which they are most

proud" (Friedman, 2000, p. 43). Though these processes of diffusing a positive representation of science can be seen quite clearly in the texts that accompany the exhibitions, images can also be used to reinforce persuasion of the public as to the value and trustworthiness of science.

Photos from archaeological diggings are a common feature in most museums of archaeology (Slide 16 – archaeological fieldwork at the exhibition "Roman presence in Cascais, Museu Nacional de Arqueologia). These images convey not only the romantic and adventurous notion of archaeological fieldwork – "photographs of working sites are always attractive, since one observes detective work about our past being carried out with shovels and in Wellingtons" (Hall, 1987, p. 215) – but can also serve as testimony of the scientific research that underlies the contents of the exhibition, legitimising it.

A similar strategy can be followed in ethnographical museums but it is far less common. However, one such example is the exhibition "Time for baskets", that dealt with not only the uses, manufacture and visual aspects of African basketry but also with the processes through which the objects reached the museum, namely the fieldwork done by anthropologists in the colonial era and by the curator of the exhibition herself in the late nineties. Artefacts were shown together with photos of the anthropologists (Slide 17 – Ernesto Veiga de Oliveira, Angola, 1971; Sónia Silva, Zambia, 1999).

Anthropological and ethnographical museums are the main public face of these two sciences; they legitimise ideas and attitudes and are much more exposed to the public gaze than academic research (Durrans, 1990, p. 164).

Although science museums shirk from controversy as much as possible (Butler, 1992, p. 116; Gregory and Miller, 1998, p. 208; Arnold, 1996, p. 7; Macdonald and Silverstone, 1992), it is sometimes attempted to present subjects that have been much maligned in the media and in public opinion in a more favourable light. Such is the case, for instance, of radioactivity and nuclear energy. In December 2004 the Science Museum of the University of Lisbon held an exhibition ("Radioactivity, signs of life") that was partly conceived locally and partly adapted from an international touring exhibition, created by the NuPECC's (Nuclear Physics European Collaboration Committee) PANS group (Public Awareness in Nuclear Science). It was quite clearly an exhibition advocating the beneficial aspects of nuclear research and its applications, with very little mention of risks and accidents. This reassuring message was conveyed both by texts and by images, such as the great photo of a luxuriant tropical forest in the section dedicated to natural radioactivity (Slide 18).

In conclusion, if in art museums images are shown primarily for their artistic or aesthetical value, in scientific museums they have several different functions. Whether these images are photographs, drawings, films or diagrams, they can be used to illustrate an argument, to contextualise artefacts, to reinforce a favourable perception, to teach a new concept. Images are part of the curator's strategy to convey a message and part of the ideology the museum disseminates among its audience.

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