

## "Science Is Not My Thing". Visitors' Attitudes towards Learning in An Italian Science Centre

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The mission of hands-on science centres is to create a friendly, fun experimental setting where all kinds of visitors will feel encouraged to explore the world and where they can find the instruments to do so.

Part of a relatively recent but increasingly rich and complex tradition of studies on the subject, our inquiry sets out to contribute to answering the question if there really is a re-awakening of the spirit of scientific exploration in hands-on museums and if so, do all visitors experience it.

The research project we are about to describe began as a degree thesis in a Masters in Science Communication of Trieste (student Monia Cardella, supervisor Paola Rodari), and therefore has the limits of a degree thesis: tackling such a complex theme and conducting more in-depth studies in the field would have required a much longer time-scale and greater resources. We believe, however, that both the method used and the results, although preliminary, are sufficiently significant to be of interest.

### **The theoretical context**

The nature and modes of learning in an informal setting is one of the most keenly debated themes in museum studies, since research on museum visitors began in the 1940s. Over the decades, thinking on the educational impact of museums has tended to converge on a number of almost unanimously shared acquired notions.

The visitor's experience in a museum can only tangentially be described as the passing on of notions from the exhibition curator to the visitor. To a large extent the outcome of a museum visit is an interweaving of the visitor's interests, beliefs and expectations (psychological context) with those sharing the experience and their reference community (social context) and, lastly, with the objects and texts in the exhibition (physical context).<sup>1,2,3</sup> This means there are many variable factors combining to shape the museum experience in visitors: demographic features (gender, age, social and educational background), but also specific motivations for visiting, and the group with which the visit is shared.<sup>4,5</sup> In fact current studies focus on the family, as the context in which learning takes place, especially through conversations between members of the group.<sup>6</sup>

Learning effects on a visitor, moreover, do not have a precise time frame. It is not simply a question of learning here and now, but a cognitive experience which is part of the temporal flow of innumerable other experiences taking place during the course of a lifetime, creating reinforcements, conflicts or adjustments.<sup>7,8</sup>

Given that, science centres are places where free individual learning is especially encouraged, and indeed where it should be stimulated even in those who have lost the habit (i.e. adults), we thought it was particularly important to investigate what really happens when visitors interact with exhibits in a hands-on exhibition. Are all visitors, albeit in different ways, intrigued by the exhibits? Do they really experience the science centre settings as

places in which they can exercise their skills at reasoning in scientific terms? And what do they take away from each individual exhibit?

We chose to observe individual visitors and not groups, so as to focus attention on any possible learning at a given exhibit, and especially on the variations that could be observed in visitors with different characteristics at exhibits with different characteristics.

We thus set ourselves the following objectives: 1) try out a simple method, within the means of even small museums, to evaluate the degrees of learning in visitors in relation to a specific exhibition; 2) compare what happens with exhibits with different communicative features; 3) highlight how visitors' attitudes to learning vary according to factors such as age and gender.

## **Research methods**

Officially opened on 15 May 2004 at Saltara (Province of Pesaro and Urbino), the Museo del Bali can claim to be a science centre to all effects and purposes. It is a state of the art interactive science museum inspired by the hands-on philosophy, designed for visitors of all ages and educational backgrounds. In addition to a planetarium, an astronomical observatory for teaching purposes, a conference area and two school workshops, the museum has a permanent interactive exhibition with thirty-five exhibits.

We deliberately chose two very different exhibits for our research: "Colour your shadow", consisting of a screen on which light is projected from three different coloured spotlights, producing areas of shadow and light with different colours; and "Falling upwards", consisting of two inclined diverging metal rods on which is placed a double-cone roller. The angle of opening of the rods is such that when the roller is let go, it "rises" instead of "falling" (this is an optical effect, in fact the roller descends, since its centre of gravity is lowered).

The first exhibit is what we could generally be described as exploratory, i.e. it alludes to various phenomena related to the properties of light and is very theatrical. There is no single action to be performed or a pre-established sequence, and the visitors can simply "mess about" for as long as and how they like. It is also not immediately obvious what visitors should understand: they can experiment on how to change the colour in the shadow and change the spotlights, but also how its forms change according to distance and inclination of the object casting the shadow, etc.

The mechanical exhibit, on the other hand, allows the user to focus on a single phenomenon, the apparently anomalous motion of a body. In this case understanding the exhibit has a much narrower sense: it means observing the apparently unnatural behaviour of the double cone and understanding that in fact there is nothing unnatural at all, since its behaviour can be explained by well-known laws of physics.

We considered a small sample: a total of 52 people – 27 at the optics exhibit and 25 on the mechanics exhibit. We chose visitors who did not interact with a demonstrator. The demonstrator is obviously an integral part of museum communications, and therefore of the visitor's learning experience. However, according to the hands-on museum philosophy, even interacting alone with the exhibit should produce a significant experience. Hence the decision to consider interactions taking place independently.

To try out the method under the most general conditions possible, there was no selection of specific age groups. We did not question pre-school children, however, so that we could have a sample of users who, if they so wished, could read the texts besides the exhibits.

In the first research stage, in addition to analysing the exhibits and the material available for visitors, we also interviewed four demonstrators. The demonstrators expressed their evaluation of visitors' behaviours, especially as regards the two exhibits being considered.

In the second stage the behaviour of visitors interacting with the exhibits was observed in an unobtrusive way. In addition to the characteristics of the various subjects (gender, age group)

who stopped at the exhibit for over a minute, we noted if they had understood the correct functioning and had read the accompanying text.

Then, after the visitors had finished interacting with the exhibit, we stopped them and interviewed them briefly.

Lastly their statements were classified according to a scale of levels of comprehension. Although fully aware that what a visitor is willing to say is not an absolute measure of his or her learning (many may not be able to explain in words a very important interior experience, or might simply not wish to speak to the interviewer), we assumed that: 1. The interviewer's statements still allow us to find elements revealing their degree of understanding, if we take into account the context of the interview and if we record the non-verbal behaviour; 2. Even in the cases when people did not wish to speak, the reasons for their refusal were considered and turned out to be extremely revealing about the attitude of some given types of visitors to the museum and/or science.

We established five levels of comprehension, ordered from a minimum (1) to a maximum (5), corresponding to five different types of discourse:<sup>9</sup>

1. Refusal to speak of the experience (e.g. "Ask him, because I have never understood this kind of stuff", woman 60 years old);
2. Appreciation and willingness to pass judgement but only in terms of whether the visitor liked the exhibit or not (e.g. "It's really nice, because you can do all sorts of things", girl 7 years old);
3. Description of how the exhibit works (e.g. "You have to press the button and see what happens", girl 12 years old);
4. Looking for analogies with other events (e.g. "it shows lots of colours, a bit like the colours in the rainbow", boy 10 years old);
5. Explanation of the phenomenon (e.g. "It's obvious, it shows you the sum of the three primary colours", woman 70 years old).

Lastly, the results of the visitor inquiry were compared with the evaluations made by the demonstrators.

## **Results - quantitative aspects**

Of the 52 visitors observed, 27 (5 females and 12 males) interacted with the exhibit entitled "Colour your shadow", and 25 (8 females and 12 males) with the "Falling upwards" exhibit<sup>10</sup>. They were chosen at random during a few days' observation in the museum (21st November, 5th December and 12th December 2004). The age distribution confirmed what the demonstrators had already told us: the visitors show fairly clear specific preferences for exhibits. Children prefer the "Colour your shadow" exhibit, which adults tend to pass by, whereas adults, especially men, prefer the mechanics exhibit.

The different power of attraction exercised by the two exhibits may be interpreted in the light of their different nature. "Colour your shadow" is a explorative-type exhibit and not surprisingly children, who are more willing to let themselves go and grasp the playful dimension of exploration, are the main users. On the other hand "Falling upwards" is a single theme one-off exhibit, mainly appreciated by adults, more inclined to focus on a single problem and find solutions to precise questions.

Of the 52 visitors observed, 43 visibly understood how the exhibit worked and they used it correctly. How far and how much they understood, or rather how much they got in terms of satisfaction, stimuli and ideas is summarised in Table 1. Some individuals obviously expressed several comments classifiable in different categories, and therefore they were counted more than once in the Table.

As we see, the majority of visitors not only expressed appreciation, but also described the exhibit and attempted an explanation (we shall discuss the ten who refused to comment below).

Interestingly, analogies are less frequent than explanations (10 and 38, respectively) and all those who expressed an analogy also attempted to give an explanation. Whereas we expected that resorting to analogies with familiar phenomena or objects would be simpler than attempting to supply a causal explanation of the phenomenon observed, we noted that only people able to produce an explanation then went on to suggest examples or analogies. Providing analogies, therefore, would seem to indicate more complex thinking than an explanation alone: i.e., first I explain what happens, and then I think of something similar.

After some initial interviews, we then re-ordered the provisional hierarchy of the various levels and gave it the following definitive form:

- comprehension 0: refusal to comment
- comprehension 1: appreciation and judgement
- comprehension 2: description of how the exhibit works
- comprehension 3: explanation of the phenomenon
- comprehension 4: analogies with another phenomenon

In Table 2 we classified the visitors' answers according to this second scale: thus each visitor only appears once, namely at the highest level reached with his or her statements.

It is difficult to classify these explanations in terms of right or wrong, and perhaps not even very correct to do so. The typical philosophy of the hands-on museum considers personal cognitive paths to differ greatly and they must be respected. We may, however, also attempt to interpret the interviewees' answers in terms of accuracy.

There were very few right and complete answers – as they might be considered in a school context: 5 out of 27 interviewees for the optics exhibits and 6 out of 25 for the mechanics exhibit. As far as the optics exhibit is concerned, 21 visitors out of 27 were willing to explain the exhibit: 5 of them did so correctly; 4 wrongly, and 12 incompletely and/or confusedly.

For the mechanics exhibit: 17 out of 25 were willing to explain; 6 did so correctly; 7 wrongly; and 4 incompletely and/or confusedly.

The explanations provided by visitors to the optics exhibit were thus usually not complete, in the sense that they did not speak at the same time about the combination of colours and the formation of the shadows but referred to one or the other phenomenon. But they were rarely totally inaccurate. For "Falling upwards", on the other hand, the answer was usually either wholly accurate or wrong. When faced with this apparent paradox, people tended to overtly admit they did not know why what is happening happens: of the 11 people who did not supply a correct interpretation of the phenomenon, 5 said they could not find an answer or were very uncertain about their suggested explanations.

With the "Colour your shadow" exhibit, on the other hand, visitors did not feel uncertain, despite the fact the number of correct answers was much fewer than for the mechanics paradox and there were plenty of incomplete answers (12 out of 16 were incorrect). The optical phenomenon thus probably appears more familiar than "Falling upwards" and less of a surprise, even though in fact it alludes to not particularly well-known physical laws.

This difference between the two exhibits was re-confirmed by the kind of value judgement made: the appreciation of the aesthetic aspect and the fact it was fun ("nice", "cool", "exciting", "fun") prevailed when speaking about "Colour your shadow", which is apparently interpreted as being pleasing but familiar, whereas in "Falling upwards", the accent is shifted to the strangeness and unusual nature of the phenomenon ("strange", "unusual", "not normal", "must be rigged").

## Results – the qualitative aspects

So far we have noted that the vast majority of visitors enjoy interacting with the exhibits and that the majority feel able to explain and describe them more or less correctly. It also emerged that the different exhibits attract different kinds of people and present different problems of understanding.

Now we should like to discuss what in medical research language would be called "non-responders", i.e. those who literally did not respond to our questions.

Ten people in our sample of 52 declared they had nothing to say about the exhibit just experienced. The non-responders for the optics exhibits were visitors who were not attracted to the exhibit and therefore did not even attempt to interact and understand the phenomenon observed. The non-responders in the mechanics exhibit, on the other hand, included two people who interacted at length and used the exhibit correctly, but despite this failed to understand it.

Significantly, all the non-responders were adults.

This not unexpected result confirms a situation well known to those who work in the sector: as we grow up, we lose the curiosity and intellectual willingness typical of children. According to the demonstrators:

“Usually the elderly – at least those that I have met – listen and if they have any doubts they keep them to themselves. I've often seen this, you can see if people don't understand from their faces, even young people. It's the children who ask more questions. They're not afraid to stick their necks out, or to say something even about many of the other exhibits. Before setting the exhibit in motion we ask them: What do you think will happen? For example, when I let the balls go... the children rush in to say that they will start and arrive together. Their parents, the adults, are little less inclined to do so – they are more passive. I have often asked the same question "What do you think will happen?" and they reply: "You will have to tell me"... Children don't have this inhibitory brake. They are more – how can we put it? – they dive in”.

(Michelangelo)

Apart from a couple of cases of people who were intrigued by the museum but then did not wish to be interviewed, all the other non-responders tended to stress not that they did not want to speak but that they *could not*. They blamed this inability on various factors: they had not yet had time to ask or listen to the demonstrator; they did not have an adequate training in science or had never understood anything about it; or they were not at the museum for themselves but simply to accompany children, friends or a relative who was particularly passionate or knowledgeable. Most of the non-responders were women (above fifty years old) who delegated the task of understanding to others (husband, friend, a demonstrator).

Interestingly, mothers accompanying children are *viceversa* among the visitors who make the biggest effort: they read the texts out loud, encourage their children and follow their progress, while they, too, have fun, almost as if the fact of having to help their children learn justifies the fact they are interested and having fun.

The overall gathered comments seem to reveal a conviction that the science centre, precisely because it features science, is a place mainly suited to children or adults endowed with special skills or interests.

The definition given by the woman mentioned above is emblematic: the museum contains "intelligent games". The hands-on exhibits mean you have to be "on your toes" and you are on your toes when you are still young (an elderly man commented "these things are meant for young people"), or if you are intelligent and have a more than average interest in scientific subjects (as one grandfather proudly claimed: "I've always been a rather inventive

type"). Therefore either you are children (and therefore the joy in experimenting will overcome any fear of outside judgements) or you are special (and feel you can speak because you know the facts). Otherwise it is better to keep away from anything that has to do with science – like those who admit that the museum "is not their thing". People are afraid of making a fool of themselves, being caught out messing about with something they are not up to.

Most visitors, although declaring they had fun and recognising the educational value of the museum, feel far removed from science and in a certain sense unable to come nearer.<sup>10</sup>

## **Conclusions**

At the beginning of this inquiry we had three objectives: 1) test a simple method within the means of even small museum structures to evaluate visitors' degrees of appreciation and learning; 2) compare what happens with exhibits with different communication features; 3) highlight how visitors' attitudes towards learning science vary according to factors such as age and gender.

Despite a limited number of observations and the brevity of the interviews, we were able to bring to light interesting issues, useful both for the general debate on learning in an informal context and the evaluation of the specific context of the museum observed. If systematically conducted by museum demonstrators, short enquiries on various exhibits would enable them to deepen their intuitions as natural observers of visitors, suggest possible improvements to the exhibits, and be more aware of comprehension problems when interacting with visitors.

Our research revealed considerable communications differences in the two exhibits chosen. Their attractiveness, capacity to stimulate scientific thinking and give satisfaction vary considerably from visitor to visitor. We believe it would be very interesting to conduct more in-depth research aimed at cataloguing exhibits according to their communication characteristics in terms of the cognitive paths they encourage in visitors. This research could cast new light on an aspect of the more general problem of learning in an interactive exhibition. It must be said that this kind of research is almost non-existent in the literature and very few experts have spoken out in its favour.<sup>11</sup>

As for visitors' attitudes, we know that science centres have to face deeply entrenched cultural resistance. The prejudice that interactive museums are basically for children and the self-conviction that adults are not up to science, which can only be approached by scientists or people with special skills (those who have been bitten by the knowledge "bug") mean that most adult visitors do not make full use of interactive exhibitions and their opportunities for fun and cultural development.

In this case, too, if the demonstrators and all the museum staff were more aware of differences in visitors, of how some categories of visitors are more refractory (e.g. woman of a certain age), then they could devise specific ways of intervening or simply take more care over encouraging these kinds of visitors.

## Tables

	<b>Colour your shadow (27 people)</b>	<b>Falling upwards (25 people)</b>
Refusal	5	5
Appreciation	22	20
Description	22	19
Analogy	6	4
Explanation	21	17

**Table 1.** Recurrences of the five levels of indicators in the comments made by the visitors questioned

	<b>Colour your shadow (27 people)</b>	<b>Falling upwards (25 people)</b>
Comprehension 0 - Refusal	5	5
Comprehension 1 - Appreciation	0	1
Comprehension 2 - Description	1	2
Comprehension 3 - Explanation	15	13
Comprehension 4 - Analysis	6	4

**Table 2.** Classification of visitors according to maximum level of comprehension shown.

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