Ten misconceptions scientists have about popularizing science

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Research

When I ask my fellow physicists what they think of science communication and outreach efforts, they all agree that it's needed. But when it comes to who should do the popularizing, how to go about it, and why, opinions vary. "We need to get young people excited about scientific careers again…" "Pedagogy is the most important thing…" "Quantum physics is to be avoided…" etc. I had firm opinions on the subject when I first began to take part in science outreach activities 12 years ago. After years of public lectures, school visits, science festivals, and collaborations with museums, I have to acknowledge that those initial opinions were gradually disproven. Here are ten "truths" that seemed self-evident to me , but that did not stand up to closer scrutiny.

To summarize, the motivations of, and relationship with the public that popular science engages are more complex than they first appear Scientists who are interested in public science communication and popularization should be aware of this, without abandoning their ambitions and ideals

1. "The public is losing interest in science."

One of the ideas I hear most often from research scientists is that the general public does not have enough scientific knowledge. It's true that if asked a basic science question, French people often get it wrong. For example, less than 20 percent identify gases and CO_2 as the cause of the greenhouse effect. A third of Europeans don't know that the Earth revolves around the sun.
But are these incorrect answers symptomatic of a lack of interest in science or rather of insufficient science at school? Because contrary to common knowledge, the general public *is* interested in science and has a positive opinion of it. To the question: "Do science and technology provide solutions to the problems we currently

face?" nearly 84 percent of those surveyed answer "Yes" (Le Monde, 2016). Better yet, 93 percent of the French population would like to improve their knowledge about at least one scientific field (Credoc, 2013). And among 15-25 year olds, 76 percent are interested in science and 95 percent have a positive opinion of researchers (CSA, 2014).

Finally, when French people are asked which activities are cultural activities, science comes second with 77 percent of the vote, just after museum visits and ahead of travel, theater, music or reading. Nearly one in two French people have visited a natural history museum or science outreach center and the growing popularity of science channels on YouTube further support these findings.

2. "Young people no longer aspire to science careers."

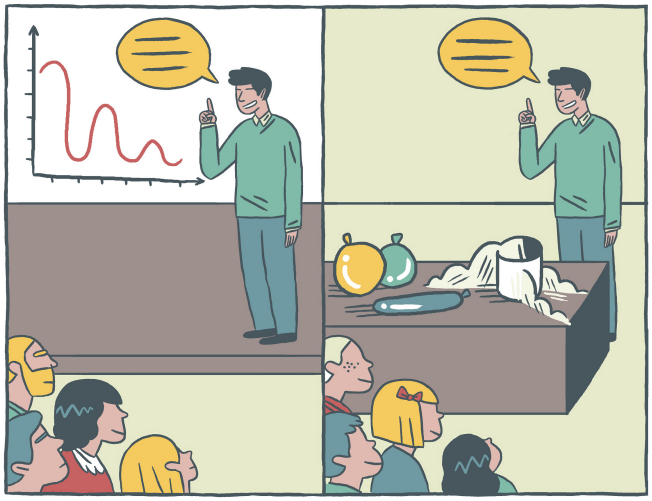
Another widespread idea, especially among academics, is that there has been a loss of interest in science subjects in recent years, which science outreach could help us to rectify. However, the number of students on science courses increased by 23 percent between 2006 and 2016, compared to 16 percent for other courses. Student numbers in fundamental science subjects at university have risen 17.7 percent, higher than the national average. Getting closer to research, numbers have increased in second-year Master's programs by almost 20 percent. At doctoral level, the number of PhDs awarded is roughly stable for French students and constantly rising for foreigners.

Putting aside these positive indicators, I am wary of the recruiting mission that some people would have science popularizers take on. Can a one-off talk at a conference or lab visit inspire students to change their minds about their future careers? The image young people have of science is first of all the one they are taught. And from this point of view, things look bad for my own discipline, physics. When asked what their three favorite subjects were at school, French people answer French (42 percent), history (38 percent), and math (34 percent), with physics coming in tenth (10 percent) (Credoc 2012). This, in my opinion, is where efforts must be made.

3. "Science outreach is mainly about being good at explaining things."

For scientists who popularize, the quality and precision of their explanations is a priority. They are worried they might approximate too much at the risk of lacking scientific rigor. But science popularization isn't teaching—and this is a university professor talking! It is impossible to be perfectly rigorous from start to finish and it doesn't matter, as long as this is clearly stated at the beginning. Having lectured

extensively on quantum physics to a lay audience, I am well aware of the "unforgivable" approximations that I am forced to make when I talk about wave-particle duality or entanglement. But thinking about it, it's the opinion of a colleague or physics teacher hidden in the audience that scares me when I make approximations rather than that of the general public.
Above all, what really has an effect on the public is often less to do with the quality of the scientific explanation than with the scientist's look, their personality, how good the PowerPoint is, the choice of colors—in short, the style. The answers to questionnaires after our high school visits speak volumes in this regard: "the scientist was wearing jeans!" "A physicist can be a woman," "And I thought physics was dead," and so on. Very few comments are about the explanation itself.



4. "In a public debate, scientific evidence is enough to convince people."

I'll get right to the point: many studies have established the list of cognitive biases that affect opponents in a debate: confirmation bias, the familiarity heuristic, the deficit model, the backfire effect, etc. Clear scientific reasoning based on objective evidence will not necessarily make people believe you; quite the opposite! For having often been faced with arguments based on pseudoscience—quantum medicine, "magnetizers," crystal healing and the like—I no longer tend to firmly oppose those who defend these practices as I did at first, but rather try to educate the rest of the audience a little about the scientific approach.

5. "Some topics are too complicated to be popularized."

I often hear that certain subjects such as quantum physics can't be explained; they are too complicated, too abstract or too mathematical. I agree, if it's a question of explaining "properly". But, if you agree to give up a certain level of mathematical rigor, it is possible to provide some information and insights, whatever the subject. As proof of this, two "impossible" subjects, the Higgs boson and gravitational waves, have been not only publicized but also popularized remarkably well since their recent discovery. The Nobel Prize for Physics, awarded every year on the most difficult subjects, is always accompanied by excellent popular science pieces on the Nobel website itself. A survey of science popularization experts indicates that none of them

believe there is a problem too complex for the main ideas to be made understandable.

6. “We should focus on subjects with concrete applications.”

Many times I have been advised that, to get the public involved, a popular science lecture on superconductivity should start with its applications, such as medical imagery or the magnetic levitation train. I don’t have any study to quote on this point, just my own impression: the public doesn’t always want to be brought back to daily life and remains fascinated by the great mysteries and fundamental questions that science poses. Just look at the best selling science books: string theory, general relativity, astronomy, quantum physics, and the cosmos. None of the bestsellers are about physics for medicine or physics applied to electronics.

7. “Some subjects will always be more popular because they capture the imagination.”

In view of the previous point, you might conclude that the most fascinating subjects—the origins of the Universe, quantum or relativistic paradoxes—will always be more captivating than the more concrete subjects. In physics, for example, astronomy and even string theory seem to go over better than condensed matter judging by the media coverage they get. Yet this imbalance has not only to do with the subject’s appeal, but also with the effort scientists make. String theorists have developed a real lobby for their discipline using terrific media representatives. Astrophysicists, likewise, get more involved and do a better job than others. At CNRS, they are five times more active in their science communication and outreach than the condensed matter physicists. The size of research centers also helps: CERN for particle physics

and ESA and NASA for space science have a tremendous impact compared to other scientific communities split into micro-teams—an inspiration for other disciplines!

8. “Researchers don’t need to do science popularization and communication, leave it to the professionals.”

Scientists have a lot of good reasons not to take part in popular science or outreach activities, from a lack of time and lack of skills to a lack of recognition. Why not let the museum facilitators and science organizations do the job?
Here again, my own experience shows that scientists’ presence is irreplaceable, not for the clarity of their explanations, but for two reasons. First, they can talk about recent research and anchor science in its modern context. But more importantly, they are the ones doing the research. They can talk about what this involves in practice, their experience and the questions they ask themselves. The number of questions we get about the research profession and research practice show that scientists’ presence is worthwhile. I argue for complementarity and collaboration between professional science communicators and research scientists, which has been my own experience with the facilitators at the Cité des Sciences, for example.

9. “Outreach takes too much time.”

This is true if you’re starting from scratch and aim to write an article or give a lecture to the general public. But there are “micro-actions” that can be done quickly and usefully: answering a few questions online, contributing to Wikipedia or Twitter, answering questions from a group of high school students for their research project, manning a booth at a science fair, writing a highlights section on your latest scientific article. There are plenty of opportunities for things that take no more than an hour or two.

10. “Outreach is bad for scientists’ careers”.

I admit, this idea is not completely ill founded. Popular science and science outreach activities are unlikely to help advance research careers in France. There are not the serious evaluation methods and political will needed for these activities to be taken into account for promotion. But they don’t necessarily do any harm either and have several benefits that we tend to overlook. Good communicators will find it easier to recruit PhD students because they are able to present their research subjects better—and I’m speaking from experience. They speak more effectively at conferences when presenting their findings to colleagues. They write better introductions to their research papers, better highlights and—the key argument—better funding applications.

Finally and most importantly, science outreach activities are a breath of fresh air, a way out to get out of the lab, take a break from your routine, and encounter a fresh, enthusiastic and curious audience!

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