

Lost in translation

Scientists need to adapt to a postmodern world; constructivism can offer a way

Monica Racovita

Political groups, civil organizations, the media and private citizens increasingly question the validity of scientific findings about challenging issues such as global climate change, and actively resist the application of new technologies, such as GM crops. By using new communication technologies, these actors can reach out to many people in real time, which gives them a huge advantage over the traditional, specialist and slow communication of scientific research through peer-reviewed publications. They use emotive stories with a narrow focus, facts and accessible language, making them often, at least in the eyes of the public, more credible than scientific experts. The resulting strength of public opinion means that scientific expertise and validated facts are not always the primary basis for decision-making by policy-makers about issues that affect society and the environment.

The scientific community has decried this situation not only as a crisis of public trust in experts but more so as a loss of trust in scientific objectivity. The reason for this development, some claim, is a postmodernist perception of science as a social construction [1]. This view claims that context—in other words society—determines the acceptance of a scientific theory and the reliability of scientific facts. This is in conflict with the more traditional view held by most scientists, that experimental evidence, analysis and validation by scientific means are the instruments to determine truth. ‘Social constructivism’, as this postmodernist view on science has been called, challenges the ‘traditional’ view of science: that it is an objective, experiment-based approach to collect evidence that results in a linear accumulation of knowledge, leading to reliable, scientifically proven facts and trust in the role of experts.

However, constructivists maintain that society and science have always influenced one another, thereby challenging the notion that science is objective and only interested in uncovering the truth. Moderate social constructivism merely acknowledges a controversy and attempts to provide answers. The extreme interpretation of this approach sustains that all facts and all parties—no matter how absurd or unproven their ‘facts’ and claims—should be treated equally, without any consideration for their interests [2].

...scientific expertise and validated facts are not always the primary basis for decision-making by policy-makers about issues that affect society and the environment

The truth might actually be somewhere in the middle, between taking scientific results as absolute truths at one extreme, and requiring that all facts and all actors should be given equal attention and consideration at the other. What is needed, however, is a closer connection and mutual appreciation between science and society, especially when it comes to science policy and making decisions that require scientific expertise. To claim that all perspectives are equally important when there is a lack of absolute facts—leading to an ‘all truths are equal’ approach to decision-making—is surely ridiculous. Nonetheless, societies are highly complex and sufficient facts are often not available when policy-makers and regulatory bodies have to make a decision. The aim of this essay is to argue that social construction and scientific objectivity can coexist and even benefit from one another.

The question is whether social constructivism really caused a crisis of objectivity and a change in the traditional view of science? A main characteristic of the traditional view is that science progresses in isolation from any societal influences. However, there are historical and contemporary examples of how social mores influence the acceptability of certain areas of research, the direction of scientific research and even the formation of a scientific consensus—or in the words of Thomas Kuhn, of a scientific paradigm.

Arrival at a scientific consensus driven by non-scientific factors will probably happen in a new research field when there is insufficient scientific information or knowledge to make precise claims. As such, societal factors can become determinants in settling disputes, at least until more information emerges. Religious and ethical beliefs have had such an impact on science throughout history. One could argue, for example, that the focus on research into induced pluripotent stem cells and the potency of adult stem cells is driven, at least in part, by religious and ethical objections to using human embryonic stem cells. Similarly, the near universal consensus that scientists should not clone humans is not based on scientific reason, but on social, religious and ethical arguments.

Another example of the influence of non-scientific values on the establishment of a scientific consensus comes from the

‘Social constructivism’ [...] challenges the ‘traditional’ view of science: that it is an objective, experiment-based approach to collect evidence...

field of artificial intelligence. In the 1960s, a controversy erupted between the proponents of symbolic processing—led by Marvin Minsky—and the proponents of neural nets—who had been led by the charismatic Frank Rosenblatt. The publication of a book by Minsky and Seymour Papert, which concluded that progress in neural networks faced insurmountable limitations, coincided with the unfortunate death of Rosenblatt and massive funding from the US Department of Defense through the Defense Advanced Research Projects Agency (DARPA) for projects on symbolic processing. DARPA's decision to ignore neural networks—because they could not foresee any immediate military applications—convinced other funding agencies to avoid the field and blocked research on neural nets for a decade. This has become known as the first artificial intelligence winter [3]. The military, in particular, has often had a major influence on setting the direction of scientific research. The atomic bomb, radar and the first computers are just some examples of how military interests drove scientific progress and its application.

The traditional perception of science also supposes a gradual and linear accumulation of scientific knowledge. Whilst the gradual part remains undisputed, scientific progress is not linear. Theories are proposed, discussed, rejected, accepted, sometimes forgotten, rediscovered and reborn with modifications as part of an ever-changing network of scientific facts and knowledge. Gregor Mendel discovered the laws of inheritance in 1865, but his finding received scant attention until their rediscovery in the early 1900s by Carl Correns and Erich von Tschermak. Ignaz Semmelweis, a Hungarian obstetrician, developed the theory that puerperal fever or childbed fever is mainly transmitted by the poor hygiene of doctors before assisting in births. He observed that when doctors washed their hands with a chlorine solution before obstetric consultations, deaths in obstetrics wards were drastically reduced. The medical community ridiculed Semmelweis at the time, but the development of Louis Pasteur's germ theory of disease eventually vindicated him [4].

Another challenge to the traditional view of science is the claim that scientific facts are constructed. This does not necessarily imply that they are false: it

acknowledges the process of independently conducted experiments, 'trial and error' approaches, collaborations and discussions, to establish a final consensus that then becomes scientific fact. Critics of constructivism claim that viewing scientific discovery this way opens the gate to non-scientific influences and arguments, thereby undermining factuality. However, without consensus on the importance of a discovery, no fact is sufficient to change or establish a scientific theory. In fact, classical peer review treats scientific discoveries as constructions essentially by taking apart the proposed fact, analysing the process of its determination and, based on the evidence, accepting or rejecting it.

Ultimately, then, it seems that social constructivism itself is not the sole or most important factor for changing the traditional view of science. Social, religious and ethical values have always influenced human endeavours, and science is no exception. Yet, there is one aspect of traditional science for which constructivism only has the role of an observer: public trust in scientific experts. Societies can resist the introduction of new technologies owing to their potential risks. Traditionally, the potential victims of such hazards—consumers, affected communities and the environment—had no input into either the risk-assessment process, or the decisions that were made on the basis of the assessment.

...without consensus on the importance of a discovery, no fact is sufficient to change or establish a scientific theory

The difficulty is that postmodern societies tend to perceive certain risks as greater compared with how they were viewed by modern or premodern societies, ostensibly and partly because of globalization and better communication [5]. As a result, the evaluation of risk increasingly takes into account political considerations. Each stakeholder inevitably defines risks and their acceptability according to their own agenda, and brings their own cadre of experts and evidence to support their claims. As such, the role of unbiased experts is undermined not only because they are similarly accused of having their own agenda, but also because the line between experts and non-experts is redrawn [5]. In addition, the internet and other communication

...the internet and other communication technologies have unprecedentedly empowered non-expert users to broadcast their opinions

technologies have unprecedentedly empowered non-expert users to broadcast their opinions. The emergence of so-called 'pseudo-experts', enabled by "the cult of the amateur" [6], further challenges the position of scientific experts. Trust is no longer a given for anyone, and even when people trust science, it is not lasting, and has to be earned for new information. This erosion of trust cannot be blamed entirely on the "cult of the amateur". The German sociologist Ulrich Beck argued that when scientists make recommendations to society on how to deal with risks, they inevitably make assumptions that are embedded in cultural values, moving into a social and cultural sphere without assessing the public view of those values. Scientists thus presuppose a certain set of social and cultural values and judge everything that comes against that set as irrational [5].

Regardless of how trust in expertise was eroded, and how pseudo-experts have filled the gap, the main issue is how to assess the implications of scientific results and new technologies, and how to manage any risks that they entail. To gain and maintain trust, decision-making must consider stakeholder involvement and public opinion. However, when public participation attempts to accommodate an increasing number of stakeholders, it raises the difficult issue of who should be involved, either as part of the administrative process or as producers of knowledge [7,8]. An increasing number of participants in decision-making and an increasing amount of information can result in conflicting perspectives, different perceptions of facts and even half-truths or half-lies when information is not available, missing or not properly explained. There is no dominant perspective and all evidence seems subjective. This seems to be the nightmare scenario when 'all truths are equal'.

It is important to point out that the constructivist perspective of looking at the interactions between science and society is not an attempt to impose a particular worldview; it is merely an attempt to understand the mechanisms of these interactions. It attempts to explain why, for example, anti-GMO activists destroy experimental field

trials without any scientific proof regarding the harm of such experiments. In addition, constructivism does not attempt to destroy the credibility of science, nor to over-emphasize alternative knowledge, but to offer possibilities for wider participation in policy-making, especially in contentious cases when the lines between the public and experts are no longer clear [8]. In this situation, expert knowledge is not meant to be replaced by non-expert knowledge, but to be enriched by it.

Nonetheless, the main question is whether scientific objectivity can prevail when science meets society. The answer should be yes. Even when several seemingly valid perspectives persist, objective facts are and should be the foundation of decisions taken. Scientific facts do matter and there are objective frameworks in place to prove or disprove the validity of information. Yet, in settling disputes, the decision must also be accountable to prevent loss of trust. By establishing frameworks for inclusive discussions and acknowledging the role of non-expert knowledge, either by indicating areas of public concern or by improving the communication of scientific facts, consent and thus support for the decision can be achieved.

Moreover, scientific facts are important, but they are only part of an informational package. In particular, the choice of words and the style of writing can become more important than the factual content of a message. Scientists cannot communicate to the wider public using scientific jargon and then expect unconditional trust. People tend to mistrust things they cannot understand. To be part of a decision-making process, members of the public need access to scientific information presented in an understandable manner. The core issue is communication, or more specifically, translation: explaining facts and findings by considering the receiver and context, and adapting the message and language accordingly. Scientists must therefore translate their work. Equally important, they must do this proactively to take advantage of social constructivism and its view of science. By understanding how controversies around new scientific discoveries and scientific expertise arise, they can devise better communication strategies.

Some examples show how better interaction between science and society—such as the involvement of more stakeholders and the use of appropriate language in



communication—can raise awareness and acceptability of previously contentious technologies. In Burkina Faso in 1999, Monsanto partnered with Africare to provide farmers with GM cotton to address pest resistance to pesticides and to increase yields. The plan was originally met with suspicion from the public and public research institutes, but the partners managed to build trust among the different stakeholders by providing transparent and correct information. The project started with a public–private partnership. By being open about their motives, including profit-making, and acknowledging

and discussing any potential risks, the project gradually achieved the full support of the main partners [9]. Another challenge was the relationship between scientists and journalists. By using scientific communicators that were both open to dialogue and careful to maintain the discussion within scientific boundaries, the relationship with the press improved [10]. In this case, efforts to translate scientific knowledge included transparency of information and contextualizing its delivery, as well as an increasingly wider participation of stakeholders in the development and commercialization of GM cotton.

...scientists[...]should consider proactively translating their research for a wider audience [...] in an inclusive and contextualized manner

When the Philippines, the first Asian country to adopt a GM food, approved Bt maize, environmental NGOs and the Catholic Church opposed the crop with regular protests. These slowly dissipated as farmers gradually adopted Bt maize [11] and the reporting media focused less on sensationalist stories [12]. Between 2000 and 2009, media coverage contributed substantially to a mostly positive (41%) or neutral (38%) public perception of biotechnology in the Philippines [12]. Most newspaper reports focused on the public accountability of biotechnology governance and analysed the validity of scientific information, together with the way in which conflicts in biotechnology research were managed. Science writers translated scientific facts into language that the wider public could understand. In addition, sources in which the public placed trust—either scientists or environmentalists—were cited in the media, which helped to facilitate public discussion [12]. In this case, the efforts of science writers to provide balanced, well-informed coverage, as well as a platform for public discussions, effectively translated the scientific facts and improved public opinion of Bt maize.

Constructivism is not a threat to science. It is a concept that looks at the components and the processes through which a scientific theory or fact emerges; it is not an alternative to these processes. In fact, scientists should consider embracing constructivism, not only to understand what happens with the products of their labour beyond the laboratory, but also to

understand the forces that determine the fate of scientific developments. We live in a complex world in which individual actors are empowered through modern communication tools. This might make it more challenging to prove and maintain scientific objectivity, but it does not make it unnecessary. Public decision-making requires an objective fact base for all decisions concerning the use of scientific discoveries in society. If scientists want to prevent their messages from being misunderstood or hijacked for political purposes, they should consider proactively translating their research for a wider audience themselves, in an inclusive and contextualized manner.

ACKNOWLEDGEMENTS

I thank Wendy Craig for helping in making this manuscript more reader friendly. I also thank Cosmina Tanasoiu, Mihaela Racovita, Ivar Thorson and Jana Frank for valuable comments coming from different areas of expertise. The opinions expressed in this manuscript belong to the author and do not necessarily reflect positions or policies of the International Centre for Genetic Engineering and Biotechnology.

CONFLICT OF INTEREST

The author declares that she has no conflict of interest.

REFERENCES

1. Kuntz M (2012) The postmodern assault on science. *EMBO Rep* **13**: 885–889
2. Martin B, Richards E (1995) Scientific knowledge, controversy, and public decision-making. In *Handbook of Science and Technology Studies* Revised Edn (eds Jasanoff S, Markle GE, Petersen JC, Pinch T), pp 505–526. London, UK: Sage
3. Olazarán M (1996) A sociological study of the official history of the perceptors controversy. *Soc Stud Sci* **26**: 611–659
4. Codell Carter K, Carter BR (2009) *Childbed Fever A Scientific Biography of Ignaz Semmelweis* 3rd Edn. Piscataway, New Jersey, USA: Transaction
5. Beck U (1992) *Risk Society Towards a New Modernity*. London, UK: Sage
6. Keen A (2007) *The Cult of the Amateur: How Blogs, MySpace, YouTube, and the Rest of Today's User-generated Media are Destroying our Economy, our Culture, and our Values*. New York, New York, USA: Doubleday
7. Elzinga A, Jamison A (1995) Changing policy agendas in science and technology. In *Handbook of Science and Technology Studies* Revised Edn (eds Jasanoff S, Markle GE, Petersen JC, Pinch T), pp 572–597. London, UK: Sage
8. Irwin A (2008) STS perspectives on scientific governance. In *The Handbook of Science and Technology Studies* 3rd Edn (eds Hackett EJ, Amsterdamska O, Lynch M, Wajcman M), pp 583–607. Cambridge, Massachusetts, USA: MIT Press
9. Ezezi OC, Barber K, Daar AS (2012) The value of trust in biotech crop development: a case study of Bt cotton in Burkina Faso. *Agriculture & Food Security* **1** (Suppl 1): S2
10. Racovita M *et al* (2013) Experiences in sub-Saharan Africa with GM crop risk communication: outcome of a workshop. *GM Crops Food* **4**: 19–27
11. Cabanilla LS (2007) Socio-economic and political concerns for GM foods and biotechnology adoption in the Philippines. *AgBioForum* **10**: 178–183
12. Navarro MJ, Panopio JA, Malayang DB, Amano N Jr (2011) Print media reportage of agricultural biotechnology in the Philippines: a decade's (2000–2009) analysis of news coverage and framing. *J Com* **10**: A01



Monica Racovita is at the Biosafety Unit, International Centre for Genetic Engineering and Biotechnology in Trieste, Italy. E-mail: racovita@icgeb.org

EMBO reports (2013) **14**, 675–678; published online 16 July 2013; doi:10.1038/embor.2013.90