CULTURES OF SCIENCE

Texts collected by

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and Bernard Schiele

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Science & You

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INTRODUCTION

The will to promote and enhance science culture today rests upon the oft-repeated observation that sciences are at the heart of what we feel 'modernity' is: they modify values just as they modify social modes of organization. This is why it is posited that initiatives to ease the access to this culture and optimize its sharing are the basic requirements to ensure that anyone concerned by the impact of sciences upon society, becomes a full participant in the debates brought about by this evolution.

However, easing the participation of the public in these debates requires us to rethink and imagine beforehand new modes of interaction with social actors in view of the strong demands for a direct dialogue with researchers on ethical, political or economic issues that arise from the impact of sciences upon society, issues judged just as important as the progress of knowledges — in plural. The issue is also to have a command over social choices that entail vastly different science policies shaping our shared future. Often, science is seen less as a mean to transform and emancipate society than as a possibility to unceasingly open new markets without changing society. And numerous are those, even among scientists, that nowadays see sciences and technologies as serving narrow interests rather than the common good. How, therefore, do we engage these publics, aware of the benefits that the development of science and technologies entails, yet are apprehensive of the interests at play?

In this context, how can we succinctly account for the diversity of actions in science and technology culture, implemented here around the world? How do we make creativity, inventiveness and imagination apparent? How to acknowledge the determination required to implement them, and the energy required to persevere? How to understand their need and pertinence?

The initiatives are numerous, yet each is grounded in a common, concrete reality: they are implemented on a given territory, at a given time, in specific circumstances to fulfill distinct needs, making each a unique project. This is why it may very well be that the rising awareness of the singularity of each action defines the evolution of the debates on the sharing of science culture today. This is why the expression *science cultures*—in plural—is increasingly favoured to refer simultaneously to the specific and singular natures of the locales, contexts and actions implemented.

In opposition to the universalist conception that long prevailed, the focus is now upon local conditions, and the development of the means for intervention tailored to these conditions. This small book gives an overview of the questions raised by science culture, as they are raised in a dozen or so countries, as well as the actions they implemented to solve the specific issues they are faced with. This book also presents a number of experiments carried in these countries. The diversity of science publicization initiatives and actions bears witness to the conviction and the creativity of those involved, as well as to the plurality of conditions specific to each countries they are involved in. The richness of these practices arises from their very diversity because the confrontation with models and practices different from our own forces a displacement of our point of view from which inevitably stems novel ideas. We hope this overview will stimulate a desire in the readers to know more about what is going on elsewhere, and a reflection upon their own point of view on science publicization.

Finally, we must remember that this overview takes place in the context of science culture international days—*Science & You*—organized by ACFAS, Association francophone pour le savoir (Francophone association for knowledge). They follow the Hubert Curien Daysin Nancy, France, in 2012, renamed *Science & You* in 2015.

Joëlle Le Marec (• 55)
Bernard Schiele (• 31)

BELGIUM

Reality of theories and realism of practices

Michel Claessens

Bringing science into culture and promoting the wider diffusion of scientific knowledge are probably as old as science itself. Let me just mention here that science cabinets have been established since the 18th century and that, when science became institutionalized, scientists were happy to share with the public the results of research and the progress of knowledge. At the end of the 19th century, the diffusion of science accelerated and amplified with the introduction of obligatory school education and a long-standing practice of popularizing the major scientific advances. In the past century, great scientists such as Carl Sagan, Stephen Hawking, Freeman Dyson, Hubert Reeves and Stephen Jay Gould were celebrated also for their talents of popularization.

After the professionalization of scientific research, countries with a strong science tradition established an institutional structure to disseminate science and contribute to integrating it into the culture of the layman. France in particular became a major player in the popularization of science by participating in the evolution of these practices and ensuring without any discontinuity an offer of high quality which landmarks include in particular the Museum of Natural History and the Conservatoire national des Arts et Métiers (respectively inaugurated in 1793 and in 1794), the Palais de la Découverte (1937), the first CCSTI (Centre for scientific, technical and industrial culture), La Casemate of Grenoble (1979), the AMCSTI, Association of Museums and Centres for the development of scientific, technical and industrial culture (1982) and the City of Science and Industry (1986). This is a long way of accomplishments, as measured by the volume and level of activities undertaken, both practical (events, training, media, etc.) and academic (specialized journals, doctoral theses, etc.).

However, for the last three decades, the situation has become somewhat confused, both in terms of the means to be used and the objectives to be achieved.

As far as the means are concerned, a reflection is still in progress on the practices and the statutes of science popularization. After several years of promoting 'scientific culture' and 'public understanding of science,' the focus is now on communication, dialogue and 'public engagement.' The key actors of scientific culture are now the so-called *mediators* of science. They have to integrate in their approaches communication techniques, interactivity, multimedia, games. One can even wonder if, all in all, it is worthwhile to popularize, inform and communicate about science. Look at the results: almost one in three Europeans still believes that the Sun is turning around the Earth! Obviously, the general context does not make things easier. And see for example the museums: most of them are not free of charge and some are even closed during the weekend! And the shelves of dusty science they exhibit are inspirational only for a minority! On the media side, the situation is no better.

There is also a lot of confusion as far as the objectives are concerned: what is the priority? What do we want to achieve? Given the disinterest of young people for scientific studies and careers, the aim seems less to spread knowledge and raise interest in science than to spend a nice moment in a space-time dedicated

to popularization. However, science communication has emerged as an essential activity to make science more attractive and restore confidence in science. Modified organisms, subatomic power stations and engineered cells: are these controversial scientific and technical advances only the most visible part of a public opinion which is now less supportive, in part because it ignores to a large extent the basics and the scientific method?

Also, probably to obtain additional financial resources, many actors are now describing scientific culture as a political action, and consider it as a toolbox enabling citizens to get involved in the decision-making process. But the reality has also called for some realism: consensus conferences, for example, which organize an explicit confrontation between skills and incompetence, do not lead to any rejection of *technoscience,* on the contrary. By recognizing the right to judge technoscientific subjects 'in total ignorance,' the society made a U-turn compared to what Philippe Roqueplo wrote in 1974.[1]

To make things even more complicated, a large number of researchers, who overwhelmingly support the promotion of scientific culture, consider that these activities are not only reducing their (limited) spare time but also negatively impacting their professional development and are keen to see the colleagues who do not deserve an academic career (according to them) embark on science communication and public engagement.

At the beginning of the 21st century, it is fair to say that supporting scientific culture, which can be defined as a pedagogical dissemination of knowledge seeking to make it (possibly together

1. "Étant donné le caractère de plus en plus scientifique et technique de notre environnement quotidien, est-il possible d'en 'user' et de se l'approprier véritablement sans connaître si peu que ce soit des lois qui le constituent? Ceux qui sont condamnés à l'ignorance (au sens scientifique du terme) ou qui se contentent de représentations souvent incohérentes ne tombent-ils pas ipso facto sous la domination de ceux dont le savoir s'avère indispensable au fonctionnement d'une 'nature' quasi totalement 'artificielle'? [...] Ceux qui consentent à ce que les sciences constituent diverses boîtes noires dont on pourrait contrôler l'usage de l'extérieur commettent une erreur" (P. Roqueplo, *Le partage du savoir. Science, culture, vulgarisation,* Paris: Le Seuil, 1974).

with its limits and uncertainties) accessible to non-experts, is still necessary and important, but reasons for this commitment today have somewhat changed. Indeed, citizens are now considered as full players in research and innovation, which implies that the walls between scientists and citizens no longer make sense, as they are all contributing to societal choices.

In addition, this commitment also has its own limits: the solutions to the current major challenges are not only technological but also require socio-politico-economic choices. Today, technosciences are fully part of our daily life and modernity, although the public has some difficulty following the transformations of our increasingly technological and rapidly changing world. Considering that the bulk of research and its applications are still discussed and decided without them, citizens feel "left behind" and scientists also feel that they are not always heard or even listened to. Many countries, with obvious success, are supporting activities related to communication, scientific mediation and engagement with democratic debate on collective issues to rebuild trust and strengthen the links between science, technology and society. But this work is not finished. The risk is that by targeting several publics at the same time, the action is diluted as it is less meaningful.

Finally, progress is still needed to recognize that science mediation is an integral part of the work of scientists and, as such, deserves to be recognized and valued throughout their careers.

Despite these remarks, I remain confident. The situation is not as bad as some people say. Having coordinated Eurobarometer surveys in the EU for several years, I see that science and technology are still important values for Europeans. Scientific culture is also more developed than we think. The European surveys have indeed revealed that scientific knowledge is progressing. Other results show that Europeans are "better educated" in science than they think and underestimate their own knowledge in this field. The French Fête de la science attracts more than a million visitors each year, and some popular science books, films and videos may capture impressive audiences. Should we see in these

results the positive repercussions of initiatives taken by more and more numerous actors, or even a plebiscite in favour of scientific culture? It is not impossible but vigilance is required. The bottle which is half filled is also half empty!

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BRAZIL

Science communication in Brazil: A step forward

Germana Barata

There is no strong science communication without science and technology (S&T) development. Brazil has increased investments, efforts and policy toward science communication after science reached maturity and international relevance at the end of the 1990s. Science communication has blossomed on a fertile terrain that S&T development promoted. It is high time for a step forward in the direction of strengthening its national and international collaboration and presence.

Although we can identify science communication activities way before we even had universities or research institutions in Brazil, the activity was mainly done by science enthusiasts. The changes started with training courses that created the necessary critical mass of science communicators to shift science communication in the country.

The first science communication courses date back to 1972, by University of São Paulo (USP), 1978 by the Methodist University of São Paulo (UMESP) and 1982 by the Coordination for the Improvement of Higher Education (Capes) (Oliveira, 2002; Caldas and Macedo, 2009). Many of the actors involved in those pioneer courses were responsible for boosting further progress in the field.

These accomplishments were accompanied by a boom in science communication magazines, TV programs, media coverage in the 1980s, mainly considering the re-democratization period from 1985 when the long lasting military regime came to an end. The political shift toward public interests directly echoed science need for openness and motivated practice in the field.

The rise of science production at the end of 1990s initiated a strong wave of government and institutional investments. The postgraduate system that had started in the mid-1960s was already fruitful and played a key role in the growth of science production. Brazilian science production in Latin America rose from 33.2 to 46.6%, and at the global level from 0.42% to 1.75%, from 1981 to 2005 (Almeida and Guimarães, 2013).

The São Paulo Research Foundation (FAPESP), the main state financing agency in the country, started a science communication scholarship program and a popular science magazine, *Pesquisa Fapesp,* in 1999. This produced a cascade effect in other states and at the federal level. The aim was to promote more visibility to the national science, mainly due to its public investments (FAPESP, 1999). The State University of Campinas (UNICAMP) started its specialization course in 1999, and a year later USP began a new edition of its 1992 course, meaning São Paulo state could establish a consistent and productive cycle of science communication.

At the federal level, an important step was taken in 2004 with the creation of the Department of Science and Technology Popularization and Diffusion (DEPDI) at the Ministry of Science and Technology, and the National Week of Science and Technology. There was a political move toward social inclusion in which science communication clearly profited. Government funding supported a great volume of public tenders that allowed for the enrichment of science communication practice and research.

From 2002 there was a rise on theses, dissertations and academic papers on science communication. This increase reflects the multidisciplinary interest, with strong contributions from

Education and Communication fields.[1] The first masters degree in science communication, created in 2008 by the UNICAMP, reinforced the production in the field. It will celebrate its 100th dissertation by March 2017. A second Masters course began in 2016 from Fiocruz, joining the efforts.

Internationally though, just a small part of this great Brazilian production appears in the main journals focused on science communication, with a tiny number of co-authored publications from other nations.[2] This may be due to some factors such as the language barrier, the tradition of publishing nationally and a lack of international collaborations.

In 2012, the national curriculum of researchers—Platform Lattes, with more than 4,5 million researchers registered—added a tab for Education and Popularization Production. It also established the Productivity Fellowship for science communication researchers, recognizing and setting the field as part of the scientific community, although science communication still does not have any impact on scientists' careers.

Niches for science communicators

Another major force to this changing environment is undoubtedly the internet and social media. They have allowed more exposure of institutions and scientists to the scientific community and society. Major Brazilian research foundations and universities publish their own online popular science magazines[3] (Barata et al., 2014), newspapers, blogs and social media profiles.

Social media, news outlets, websites, and all access and public interaction data (downloads, shares, likes, tweets, comments, visualizations, etc.) have produced a series of potential alternative indicators to track social interactions to scientific contents. The

1. G. Barata, M.G. Caldas et T. Gascoigne (submitted paper).
2. Idem.
3. *Minas Faz Ciência, Bahia Ciência, Pesquisa Rio, Unesp Ciência, UFSC Ciência, Amazonas Faz Ciência, Revista Pré-Univesp, Darcy* and *A3* are some examples.

so-called altmetrics have already been adopted by Web of Science, Scopus—two of the most prestigious journal databases—as well as by high-impact journals as *Nature, Plos One* and *The Lancet,* and other initiatives as Impact Story that provide scientists tools to check their research "social impact."

Brazilian science journals are seeing the value in these steps to generate more international impact and are coming to recognize online impact as part of their push for science communication. The most important national journals database, SciELO (Scientific Electronic Library Online), determined in July 2015 that the use of social media and blogs is imperative for publications indexed on the database.

Some Brazilian journals that have experience with communication on social media and blogs have even changed their view on the journal role. They declare having received more submissions and paper downloads, improved their contact with peer reviewers and widened their readership. As Brazilian journals are mainly published in open access, we face a great opportunity to share scientific content, reach society faster, get feedback, motivate open science and value the national relevant information. Alperin (2015) has shown that half the papers at SciELO are accessed by non-experts. SciELO gets more than 700,000 downloads daily.

Parallel to training, online engagement is a huge practice that is making science communication part of scientists' work. Science blogs continue to multiply—although not at the same rate as in past years—and there is a also a collective initiative Science Vlogs Brasil (blogs in video format) at YouTube with 30 channels mostly conducted by postgraduate students and science journalists. In just one year, the vlogs have successfully attracted millions of views and proven to be an alternative and relevant science media.

Future challenges

From this rich scenario, Brazil has achieved the capability to develop national know-how. The next step should be to join and strengthen national initiatives for regular and wide evaluation research in a national and international level. So far, only the public perception of science survey is been done systematically (1989, 2004, 2006, 2010, 2015). Other potential areas to monitor periodically exist within the media, science institutions ranks, the National Week of S&T, science museums, science journalists' community, and through research bids. Re-establishing the Brazilian Association of Science Journalism (ABJC) or creating a new organization could be an important way to act as a strategical community body to engage more resources and a presence in policy matters.

This need has become even more critical after the Department of Popularization of Science has been interrupted as a way—the government claimed—to cut down expenses on rearrangements on ministries. The deep economic crisis Brazil is immersed in, with huge investment cuts to S&T, means that the science communication community should take care of the great accomplishments of the last 20 years.

Altmetrics can provide a measure to value science communication as part of scientists' productivity, and motivate journals to widen their readers outside the scientific community. On this matter, open access is also a growing relevant issue and science communicators should also push journals on their field to go in this direction. More research bids should consider social media (vlogs, blogs and social) as a strong and potent tool to increase dialogue between science and society, exposure to the global community and a way to include other actors (not only scientists) on this effort.

Getting international is also important to fortify the field. Brazil has a productive history and know-how to share. Nevertheless, its collaboration worldwide is still smaller than its capacity. The international community should also be aware that there are also other countries underrepresented in the international scenario of science communication, as the United States and the United Kingdom stand out as the dominant contributors. A more varied representation of science communication practice and research should work as a catalysis to science communication worldwide.

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CANADA

Disrupting the political frame: Science-informed social movements

Michelle Riedlinger

In this piece, I examine public attempts to disrupt the government framings of impending Canadian policy decisions related to climate change mitigation through appeals to science. Below is an extract from an interview with *The Guardian* provided by The Right Honourable Justin Trudeau, Prime Minister of Canada, in December 2016. The Prime Minister says:

> The facts around climate change are fairly, fairly well established. It's not a debate on whether or not it's happening. It's about how you respond to it…When people realise that it's a tremendous business opportunity to lead on climate change, Canada will already have a head start… There continues to be fossil fuels that the world wants and, you know, whether someone's car is filled from gas from Saudi Arabia or the Oil Sands, ah, they're going to be emitting it but at the same time, we can demonstrate that the way we are extracting and developing our oil resources, our fossil fuel resources in Canada is cleaner, is more innovative, is less dangerous, is more responsible than anywhere else in the world because we've already

> shown tremendous innovations and abilities to do that. At the same time, we're raising our efficiency standards on end users. We are driving people towards public transit by creating better investments… I'm really just focussed on doing right by the values that Canadians asked me to, ah, to embody as I serve them. And I'm working hard to show that you can have engaged global perspectives and growth that works for everyone, growth that works for the middle class, ah, then that diffuses a lot of the uncertainty, the anxiety, the populism that is surfacing in different pockets around the world.[1]

This extract draws attention to Canadian government policies that support business opportunities associated with the continuing use of fossil fuels. It also highlights the need to reflect the values of Canadians who are concerned with economic growth. In this piece, federal government policies to mitigate climate change rely on industry efficiencies and individual fossil fuel reduction efforts by Canadian citizens. What are we to make of this from a science communication perspective?

Canada's science policy analysts recognize that the current Canadian government's election campaign rested on promises of supporting science and prioritizing scientific evidence in policy making.[2] Matthew Nisbet argues that public anxiety around the negative effects of globalization is responsible for the diminishing role of scientific facts in policy making and political discourse in the United States.[3] From this perspective, support for expanding fossil fuel export and a focus on the economy is explainable, but inconsistent with a federal government platform promoting

1. Kassam, A. and L. Mathieu-Léger. Dec. 15, 2016. "Justin Trudeau: Globalisation isn't working for ordinary people." *The Guardian*. Retrieved from https://www.theguardian.com/world/2016/dec/15/justin-trudeau-interview-globalisation-climate-change-trump.

2. Hariri, M. March 31, 2016. "Chief Science Officer or Advisor." *Canadian Science Policy Centre*. Retrieved from http://www.sciencepolicy.ca/news/chief-science-officer-or-advisor.

3. Nisbett, M. 2017. "Ending the crisis of complacency in science." *American Scientist*, Vol. 105, N°. 1, p. 18. DOI: 10.1511/2017.124.18.

evidence-based policy decision making—unless fossil fuel expansion can be framed positively in terms of climate change evidence.

The Canadian government's approach to climate change, science and communication

Scientists and science communicators in Canada have celebrated the most recent change in Canadian government leadership because of actions that are consistent with a government putting scientific evidence at the forefront of government decision-making.[4] Within this frame, climate change evidence pointing to the need to reduce CO_2 emissions is generally accepted as "fact," as the extract from *The Guardian* article above shows. Using the terminology of policy evaluator Carol Weiss, the Canadian government has accepted the importance of climate change research at a conceptual level, meaning that it must now factor this knowledge into discussions on the topic.[5]

However, the Canadian government also recently announced that it is approving a pipeline project (the Kinder Morgan pipeline) to increase the transfer Alberta bitumen to the West Coast of Canada. *The Guardian* interview above by the Prime Minister attempts to reframe the "fact" of climate change as a rationale for promoting actions by individuals while still supporting fossil fuel industry expansion. Within this "policy frame" are practices that reduce the impact of fossil fuel extraction to minimize harm. The Prime Minister Justin Trudeau received extensive criticism from environmental and First Nations groups for the Kinder Morgan pipeline decision. He has been accused of going

4. The Liberal government has negotiated a new employment contract for federal government scientists, giving them the right to speak freely to the media about their research. They have restored the long-form census, and the Minister of Science, Honourable Kristy Duncan is conducting an open search for a Chief Science Advisor to provide scientific advice to the Prime Minister and government.

5. Weiss, C.H. 1979. "The many meanings of research utilization." *Public Administration Review*, Vol. 39, N°. 5, p. 426–31. Retrieved from http://www.jstor.org/stable/3109916.

back on his election promises of recognizing research evidence in environmental protection and climate change mitigation[6]. I will focus on one instance of online citizen advocacy where citizens, highly engaged and committed to climate change mitigation, attempt to put science back into policy decision-making to re-establish the primary place of scientific evidence in the current Canadian socio-political context.

Democratising climate change knowledge

On 23 November 2016, the Canadian Government's Minister of Environment and Climate Change, the Honourable Catherine McKenna, hosted a National Youth Summit on Climate Change. The summit brought together a government-selected group of 100 Canadian youth from the Ottawa–Gatineau region to hear from experts in sustainable food systems, transportation and clean energy.[7] Youth attending the forum and those participating online via a live Facebook broadcast and Twitter feed were encouraged to ask questions and "offer innovative solutions."[8]

Events of this kind are common in Canada; however, science in society critics have pointed out that this kind of public engagement can suffer from too much sponsor interference and a lack of citizen control over the final outcomes.[9] Government sponsors of the youth forum excluded youth who were known to be already active in efforts to reduce support for the fossil fuel industry in Canada. Invited participants were not called on to make policy-relevant recommendations to the government beyond those that

6. Fekete, J. Dec. 1, 2016. "Economic boon or environmental disaster? How to navigate Canada's murky pipeline debate." *The National Post*. Retrieved from http://news.nationalpost.com/news/economic-boon-or-environmental-disaster-how-to-navigate-canadas-murky-pipeline-debate.

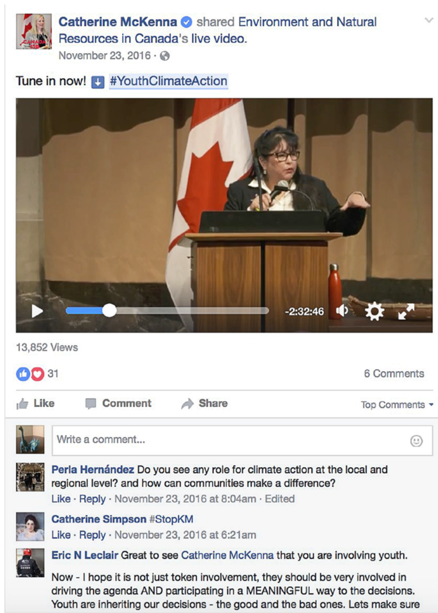
7. Office of the Minister of Environment and Climate Change. Nov. 23, 2016. "Minister McKenna holds national youth summit on climate change." *Government of Canada*. Retrieved from http://news.gc.ca/web/article-en.do?nid=1159429&tp=1.

8. Ibid., par. 3.

9. Bucchi, M. and B. Trench. 2016. "Science communication and science in society: A conceptual review in ten keywords." *Tecnoscienza*, Vol. 7, Nº. 2, p. 151–68. Retrieved from http://www.tecnoscienza.net/index.php/tsj/article/view/277/181.

would support individual or local community-based changes. The Minister of Environment and Climate Change claimed that #YouthClimateAction reached "well over 500,000 Canadians on social media."[10] However, the Department had less control over the participation of off-site participants on social media feeds using the hashtag.

Facebook and Twitter hashtag conversations using the official hashtag were dominated by posts from off-site participants focussed on the lack of discussion around the imminent approval of the Kinder Morgan pipeline project. The most prevalent hashtags in addition to #YouthClimateAction were #StopKM, #KinderMorgan, #KeepItIntheGround, #climatechange and #COP22. Off-site participants also appealed to Honourable McKenna directly through her Twitter handle. For example:



10. Office of the Minister of Environment and Climate Change. Nov. 23, 2016. "Minister McKenna holds national youth summit on climate change." *Government of Canada*. Retrieved from http://news.gc.ca/web/article-en.do?nid=1159429&tp=1

Fatin Chowdhury @fatinic · 23 Nov 2016
if @cathmckenna wants to hear from young ppl, we have been clear : #stopKM, respect treaty rights, & #keepitintheground. **#youthclimateaction**
3 33 44

In reply to Catherine McKenna
Queenskitty @Queenskitty · 23 Nov 2016
@cathmckenna **#youthclimateaction** how can you justify more pipelines and CO2 emissions, when the planet is struggling. Is there no other way?
1

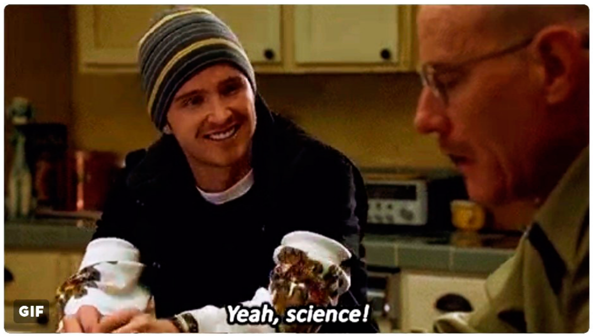
Of particular note, off-site participants appealed to scientific consensus around the causes of climate change and the need for government decision-making that acknowledged climate science. For example:

Laura Cameron @laurapcameron · 23 Nov 2016
I hope you will distinguish yourselves from the Harper govt by respecting the science and #StopKM @cathmckenna **#youthclimateaction**

> **Aurore Fauret** @uneaurore
> More scientists in Canada basically telling @JustinTrudeau that #KinderMorgan is bad news. #cdnpoli #stopKM cbc.ca/radio/quirks/e...

3 1

Christellar christellar · 23 Nov 2016
#YouthClimateAction: continuing to avoid, ignore or put-off solutions for #ClimateChange is fundamentally negligent



In reply to H. And
Wheres the Democracy @frackfreenb · 23 Nov 2016
@HiHo780 It's pure ignorance to ignore peer reviewed scientific consensus It's self righteousness at it's worst
#youthclimateaction
1 1

The online disruption attracted attention from citizen advocacy and citizen news organizations.[11] These groups framed theses citizen online advocacy actions as opportunities for young scientifically literate people to have a legitimate voice in a government-sponsored conversation.[12] Contributors voiced their disappointment about the forum, promoted awareness about advocacy groups, and introduced other hashtag conversations that were happening outside of sponsor control. For example:

YourPSC @UOIT_DC_PSC · 23 Nov 2016
@environmentca Climate leaders don't build pipelines. #Keepitintheground #UnitedAgainstPipelines **#youthclimateaction** #cdnpoli

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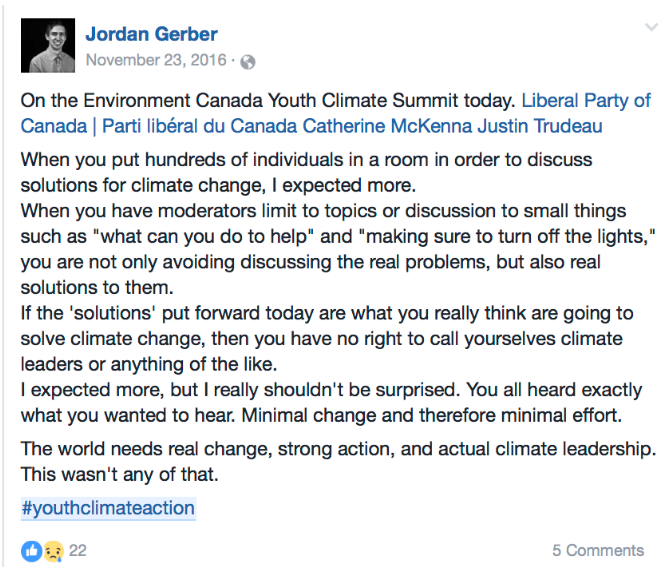

Jordan Gerber
November 23, 2016 ·

On the Environment Canada Youth Climate Summit today. Liberal Party of Canada | Parti libéral du Canada Catherine McKenna Justin Trudeau

When you put hundreds of individuals in a room in order to discuss solutions for climate change, I expected more.
When you have moderators limit to topics or discussion to small things such as "what can you do to help" and "making sure to turn off the lights," you are not only avoiding discussing the real problems, but also real solutions to them.
If the 'solutions' put forward today are what you really think are going to solve climate change, then you have no right to call yourselves climate leaders or anything of the like.
I expected more, but I really shouldn't be surprised. You all heard exactly what you wanted to hear. Minimal change and therefore minimal effort.

The world needs real change, strong action, and actual climate leadership. This wasn't any of that.

#youthclimateaction

22 — 5 Comments

Conclusion

While some science communicators may lament the loss of elite control over the public sphere as a loss of control over important messages, others may welcome digital technology for the public engagement potential it offers.

Social media platforms allow space for socio-politically motivated communication niches to proliferate. Citizens will engage in scientific discussions that involve the framing of issues when they are afforded legitimized spaces to do so. Scientific evidence points to the need to reduce government support for fossil fuel expansion, and scientifically literate citizens are attempting to hold policymakers accountable to acknowledging scientific evidence in their policy decisions. The impact of these advocacy efforts is difficult to assess; however, researchers already acknowledge that advocacy groups have greater opportunities for success in creating policy change if community members are

scientifically literate.[13] Open science for consensus building and support for scientifically grounded social movements are needed now more than ever.

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CANADA

Participation and engagement

Bernard Schiele

This short information note explores the contemporary forms of citizen participation and engagement. It gives voice to those who, until now, were excluded from debates on issues of concern to them. Because their lived experience and knowledge was undervalued and inoperative, not meeting the recognized competency criteria, they were deprived of the right to speak. Instead, that right fell to those who could claim it, especially in fields of expertise in science and technology. This monopoly on the right to speak, reserved for those few, is nowadays called into question in part because the problems facing contemporary societies need solutions that go beyond a narrow techno-scientific perspective.

Moreover, the mode of interaction now called *public participation* or *engagement* involves a *two-way communication* between experts, scientists, decision-makers and laypersons, the uninitiated, the non-specialists, citizens—unlike one-way science communication which until now has characterized and dominated the relationships between the scientific community (or its representatives and spokespersons) and the general public. In tangible terms, *public* *participation* and *engagement* involve decision-making processes on questions that affect a community (for example, environmental issues, health risks) by uniting around these questions actors of diverse competencies and interests so they can interact together to reach a consensus. *Engagement* can be direct: public meetings, panels of experts and citizens, public hearings, deliberative groups, etc. or indirect: public consultations, discussion groups, and so on.

However, the PE movement is globally larger and multiform: it ranges from publicly speaking at a town hall meeting to coproducing new knowledge in participatory research. Thus, it covers distinct modes of participation in the pursuit of specific goals. Although we can refer to it as a two-way communication between experts and laypersons, no definition exists that can adequately encompass all possible participatory practices. Thus, we must see this movement as involving a broad scope of distinct and distinctive practices. We must recognize that, when a situation so requires, social actors, as members of distinct communities pursuing their own collective interests, mobilize or are mobilized around issues, to debate or reach a consensus with all interested parties.

Paradigm change

The *deficit model*: A one-way communication mode

At the height of the hegemony of scientific discourse, the *deficit model* was the hegemonic paradigm of the relationship between the lay public and sciences, and on the role that scientists had to play. Today, in view of its status as an unquestionable evidence and of its impact upon science communication practices that developed in the wake of World War II, we can understand it as "an ideology in practice" (Schiele, 2008).

To put it simply, the *deficit model* relied on two assumptions: 1) the general public was scientifically illiterate; 2) thus, they could not understand the work done by scientists, and even less understand their worldview and share it. Therefore, it was

believed that the public could not appreciate the value of science and therefore discuss the issues it poses. Thus, prior to forming any opinion on science topics, the public should know more science.

In practice, the *deficit model* reproduced the dominant school model at the time: with the scientists and science communicators as teachers, and the purportedly unlearned public as pupils. However, this model cannot fill the knowledge gap between the public and the scientists, while the relentless pace of new knowledge production makes it even more unlikely to do so, regardless of the efforts invested (Schiele, 2013). Finally, although they affect the general public, the *deficit model* strengthens a technocratic approach that limits the tackling of science and technology issues to experts.

Beyond the *deficit model*

From the 1990s on, attempts have been made to go beyond the *deficit model*, putting a new emphasis on two-way communication between scientists and the public that goes beyond the mere transmission and acquisition of scientific knowledge. Recognizing the right of citizens to express themselves, be listened to and heard on issues that affect or may affect them is nothing short of a radical paradigm change. From now on, "citizens are entitled to a say on issues that affect their lives' (Einsiedel, 2010: 182) and not just experts.

Thus, the issue moved from the mastery of scientific knowledges—plural—to the exercise of democratic rights. In parallel, as a result of a profound mindset change, it is now recognized that "lay people are able to grasp and deal with complicated technical matters and can bring valuable insights that may not otherwise be considered by experts" (Einsiedel, 2010: 182). In other words, their abilities are acknowledged and their experience taken into account.

This movement, that promotes public participation and engagement is built around the concept of deliberative democracy. Far from equating lay knowledge with the experts' or scientists' knowledge, it nonetheless considers that it is from the pooling of a diversity of abilities and points of view that genuine solutions to the problems that affect all implicated actors will arise.

In short, the move to a two-way mode of interaction to achieve a common goal signals a profound change in society. It relates, first, to a transformation of the role of institutions in our modern complex societies, and, second, to an evolution of the relationship to knowledge. Thus, expertise is being redefined: previously marginalized forms of knowledge—often localized and local—are now recognized and integrated in the decision-making process.

The origins of participation and engagement

This evolution leads to a recasting of the science communication apparatus, of the content of the exchanges and of the interactions of its actors. With the new keywords of "participation" and "engagement," in reaction to the old model of unequal and unilateral communication of knowledge between the literate speaker and the illiterate listener, symmetrical relationships between actors are now encouraged. However, symmetry does not imply that actors can claim to have abilities and knowledge they have not acquired: scientists—physicists, chemists, biologists—will remain scientists, accountants will remain accountants, and so on, because roles and abilities are not permutable. This is not the issue.

The society we live in is often called complex. In fact what we refer to is a modern society characterized by the growing reciprocal interdependency of individuals in which no one and no group can successfully claim to be its centre. This is why *collaboration*, *participation*, *dialogue* and *engagement* are the words that come back most often in the drafting of strategies when major changes are anticipated. This applies every time what is at stake is the impact of science and technology, since they always have social outcomes.

Additionally, the *deficit model* paradigm referred to an undifferentiated public and to science, scientists and the public

as homogeneous entities. Investigative techniques designed to assess the public's science culture all took this premise, even when sociodemographic and socioprofessional variables were refined: an average individual standing in for an undifferentiated public. However, no public is monolithic. "Members of the public differ in personal experiences and knowledge, educational achievements, cultural backgrounds, personal beliefs, income, and so on" (Allgaier, 2010: 132). In short, the public is heterogeneous.

Finally, it must be stressed that these transformations are based on the equality of interlocutors and the reciprocity of their exchanges as well as a greater transparency, since it is the conjunction of these three factors that make the success of participation and engagement possible. The favoured *modus operandi* is a deliberative process towards a decision, although it is not the only one. For these very reasons, the greatest possible participation is preferred.

Figure 1, below, summarizes the transformations we are witnessing.

Figure 1 • **From deficit paradigm to engagement paradigm**

Relationship	Deficit paradigm One-way communication	Engagement paradigm Two-way communication
Interrelation	Asymmetric	Symmetric
Interpersonal	Compel	Collaborate
Interaction	Authority	Equal rights
Condition	Dependence	Autonomy
Behaviour	Submission	Reciprocity
Personality	Undifferentiated	Differentiated
Knowledge	Transfer	Mutualization

Conclusion

In conclusion, we assert that participatory practices, *participation* and *engagement* can be grouped in three general categories:

1) Modes promoting dialogue range from "information transmission to information exchange or critical dialogue" (Einsiedel 2014), which includes *town hall meetings* and science cafés, but also festivals, a number of exhibitions and online discussions.

2) Modes promoting engagement focus on deliberative processes between citizens to reach a decision. Some see it as a renewal of democracy in the form of deliberative democracy, against the shortcomings of representative democracies as practiced by most institutions worldwide (Chambers, 2003). Thus, it is the transposition of a political theory to the field of science and technology communication.

3) Modes promoting knowledge co-production mainly bring together amateur volunteers known as citizen scientists who collaborate with researchers to produce new knowledges. This process aligns with the wider transformation of knowledge production which is increasingly object-oriented, and for this reason, transdisciplinary. Research is often conducted by teams of digitally interconnected members operating from different locales. This mode is also made possible by the recent possibility of mobilizing a cost-free workforce with a wide-range of abilities. The recent acknowledgement of the contribution of traditional or indigenous knowledge on the one hand, and of the knowledge produced by patient organizations on the other, is part of the same movement.

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CHINA

Culture of innovation

Luo Hui

Importance of innovation culture incubation

In a new knowledge-based economy era, China is contributing richer innovation outcomes to the world—internationally, the rising Chinese power is valued more in the scientific innovation field, and nationally independent innovation is stressed more by the Chinese mass. Stressing innovation results and investing in the innovation processes, however, cannot sustain long-term innovation development or continuous improvement of innovation capability, though these actions result in abundant outcomes in a short time. A country's economic development is increasingly dependent on technology innovation; constructing a favourable academic environment and building an efficient innovation culture atmosphere are the key factors for sustaining long-term innovation. Consequently, they are crucial for any country underlining economic development aspects.

Some scholars have carried out research related to the academic environment with innovation, culture, national development and other aspects in China (Xie-lin and Xin-zhu et al., 2009; Jing, 2012; Dong-hai, 2014). This research probed into the significance of academic environment construction in talent cultivation, innovation resources input and other fields, falling short of any support of empirical research facts. Microscopically, the research involved many case studies and described the current academic environment state, but failed to give a macro layout at the national level. Therefore, to plan an overall layout of domestic academic environment construction and analyze the influence of academic environment on science and culture and innovation culture, the National Academy of Innovation Strategy of China Association for Science and Technology (CAST) initiated a third-party assessment in the country's status of academic environment construction.

Research thinking and indicator system building

To fully understand the domestic academic environment's construction condition, researchers conducted a variety of investigations in an academic environment (Cao-jian and Wang-jiankang, 2009; Xia-ling, 2012) and analyzed the indicator systems applied in the existing investigations. Additionally, some country policies (Appendix 1) closely related to academic environment construction and science and technology system reform were selected and included in key assessment criteria; the content of some policies was incorporated into the assessment indicator system. The following considerations were made to build the indicator system: 1) strive to fully grasp the current academic environment status; 2) emphasize analysis on the key problems in current academic environment; and 3) perfect the reference factors in assessing an academic environment. Finally, researchers defined assessment content focusing on object levels such as macro-policy environment, scientific research management environment, academic democracy environment, academic integrity environment and human development environment, proposed corresponding criteria and indicator levels for the object levels above, and captured the key data with a questionnaire (Appendix 2).

Macro-policy environment includes a scientific research management system, scientific research basic construction and a talent system, and is considered in academic environment construction orientation at the national system level. Scientific research management environment involves scientific researchers' activities and management autonomies, and values the academic environment of the scientific researchers' organizations at the management level. Academic democracy environment, combined with academic freedom and evaluation system, is applied to assess system environment construction of the scientific researchers' organizations. The academic integrity environment includes the condition of academic integrity system construction and academic misconduct; it describes the circumstances surrounding academic morals and ethics. Lastly, human development environment refers to the young scientific researchers' growth environment and the construction of scientific research teams. This is applied to state the team building in scientific research. Based on the indicator system's top-level design, researchers refined the criteria levees and created a series of indicator levels used to design questionnaires (Appendix 2).

Technical routing and survey

Scientific researchers are key in an academic environment. Consequently, research was limited to researchers in key universities, colleges and scientific research institutes. Twenty-four thousand scientific, technical and administrative personnel were respondents selected in 30 provinces, municipalities and autonomous regions across the country. Of the respondents, 8,000 were sampled at random. Special quantization tables, designed for academic environment construction at an intermediate level, were used to assess the academic environments in scientific institutions, technological associations and other organizations. Questionnaires were administered for scientific researchers and administrative personnel, and were jointly distributed and collected by CAST, country-wide societies, CAST branches and the National Scientific and Technical Worker Status Survey System.

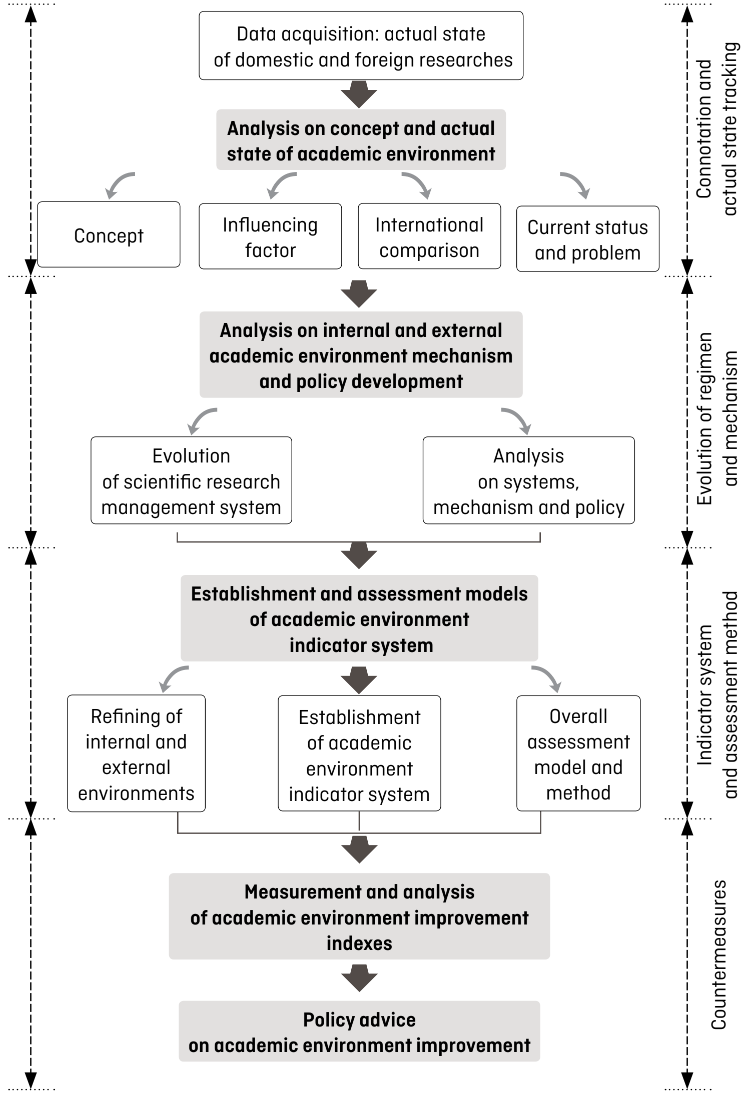
The technical routing adopted in this research is shown in Figure 1.

Chief conclusion

According to the investigation and research, the academic environment construction at the macro-policy level is relatively perfect. Overall scientific researchers are satisfied, considering that the existing environment is in favour of scientific research and innovation. At the micro level, the construction conditions of scientific research management environment, academic democracy environment and academic integrity environment are fine, but some details need to be improved further. For instance, the disposition of equipment in a scientific research management environment should have higher flexibility; clearer working principles must be developed to appraise experts with the same occupation in an academic democracy environment, and the faith system in an academic integrity environment needs to be improved further. With respect to the human development environment aspect, scientific researchers gave advice on scattered points and proposed dimensions, such as long-term realization of individual design, coordination of individual scientific research objectives and integral institution objectives not covered by the indicator system, that summarized existing problems and led to improving the indicator system.

According to the research, overall academic environment construction is sound, though it is different among regions, sectors and fields. For example, the academic environment in the eastern region is superior to the environment in central and western regions. The environment in large-scale scientific research institutions is better than middle- and small-scale ones; and academic environment construction in popular research fields is obviously more stressed than other fields. In consequence, researchers considered that the domestic academic environment should be improved in many ways: developing enforcement regulations should be boosted based on perfect macro policies;

Figure 1 • **Technical routing for assessment on "Status of academic environment construction in China"**



academic environment construction in undeveloped regions should be stressed with an appropriate intensity (applicable to an academic environment construction); and the macro academic environment should be adapted to local conditions. At the micro level, academic environment construction in middle- and small-scale scientific research institutions should greatly highlight the concourse of minute forces; the academic environment in varied disciplines should be improved while popular fields are highly valued; and a long-term innovation culture environment should be constructed.

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Appendix 1 • List of policies relevant to academic environment construction

1. Directive Opinion of the General Office of the State Council on the Improvement of Academic Environment (Guo Ban Fa [2015] No. 94)
2. The Several Opinions of the State Council on Building a Powerful Intellectual Property Nation under New Conditions (Guo Fa [2015] No. 71)
3. Opinions of the General Office of the State Council on Reform and Improvement of Postdoctoral System (Guo Ban Fa [2015] No. 87)
4. *Plan for the Implementation of Deepening the Science and Technology System Reform,* printed and distributed by the General Office of the CPC Central Committee and the General Office of the State Council
5. Notice of the General Office of the CPC Central Committee and the General Office of the State Council on Printing and Distributing *Plan for the Implementation of Deepening the Science and Technology System Reform* (Zhong Ban Fa [2015] No. 46)
6. Several Opinions of the CPC Central Committee and the State Council on Deepening the Reform of Systems and Mechanisms to Accelerate the Implementation of Innovation-Driven Development Strategies (Zhong Fa [2015] No. 8)
7. Notice of the State Council on Issuing the Program for Deepening the Reform of the Administration of Central Finance Science and Technology Plans (Guo Fa [2014] No. 64)
8. The Several Opinions of the State Council on Accelerating Development of S&T Service Industry (Guo Fa [2014] No. 49)
9. Notice of the General Office of the State Council on Forwarding the Directive Opinions of the Ministry of Science and Technology on Accelerating the Establishment of the National Technical Report System (Guo Ban Fa [2014] No. 43)
10. Regulations on the Personnel Management of Public Institutions (Order No. 652 of the State Council, implemented on July 1, 2014)
11. Several Opinions of the State Council on Improving and Strengthening Administration of Scientific Research Projects and Funds Supported by Central Finance (Guo Fa [2014] No. 11)
12. Notice of the State Council on Approving and Relaying the Several Opinions of the National Development and Reform Commission and Other Departments on Deepening Reform of the Income Distribution System (Guo Fa [2013] No. 6)
13. Notice of the Central Committee of the CCP and the State Council on Printing and Distributing Opinions on Deepening the Reform of the Science and Technology System and Accelerating the Construction of the National Innovation System (Zhong Fa [2012] No. 6)
14. Directive Opinions on Advancing the Reform of Public Service Units by Classes (Zhong Yin [2011] No. 5)
15. Outline of the Plan of the National Medium- and Long-Term Talent Development (2010–2020) (Zhong Fa [2010] No. 6)

Appendix 2 • Indicator system for academic environment construction improvement

Object Level	Criterion Level	Indicator Level	Date Source
Macro-policy Environment	Scientific research management system	Administrative interference degree	Questionnaire
	Scientific research infrastructure construction	Rationality of scientific research funds allocation	Questionnaire
		Scientific research infrastructure sharing	Questionnaire
		Collaborative innovation	Questionnaire and statistical data
	Talent system	Competitive force of personnel system	Questionnaire
		Classified assessment	Questionnaire
		Commercialization system of research findings	Questionnaire
Scientific Research Management Environment	Scientific research activity autonomy	Academic activities decision-making	Questionnaire
		Working mode and time	Questionnaire
		Academic exchange autonomy	Questionnaire
	Scientific research management autonomy	Funds use autonomy	Questionnaire
		Staffing decision-making power	Questionnaire
		Equipment disposition autonomy	Questionnaire
Academic Democracy Environment	Academic freedom	Academic disputation activeness	Questionnaire
		Administrative interference degree (with macro-policy environment—scientific research management system)	Questionnaire
		Research work time guarantee (with scientific research management environment—working mode and time)	Questionnaire
	Academic assessment	Appraisement of experts of same occupation	Questionnaire
		Application of academic appraisement results	Questionnaire
Academic Integrity Environment	Construction of academic integrity system	Perfection degree of academic integrity system	Institution questionnaire
		Effect of academic integrity supervising mechanism	Questionnaire
		Comprehension degree of scientific researcher	Questionnaire
	Academic misconduct	Severity of academic misconduct	Questionnaire
Talent Growth Environment	The youth's growth environment	The youth's academic opportunities	Institution questionnaire
		The youth's awarding system	Questionnaire and statistical data
		The youth's subsidization system	Questionnaire
		Talent introduction	Institution questionnaire
	Team building	Universality of scientific research team	Questionnaire
		Openness of scientific research team	Questionnaire

FRANCE

Culture scientifique: Breaks and continuities

Andrée Bergeron

In a recent paper, Bernadette Bensaude-Vincent called for a "situated history" of the scientific and technical culture (culture scientifique et technique), which she describes as a specifically French movement emerging in the eighties and nowadays supplanted by a movement of public participation.[1]

Clearly, the *culture scientifique* movement appears to the historian as originating in a precise context: the early-eighties France. Nonetheless, what we go on calling *culture scientifique* joins in a longer filiation. Re-placing this episode in a longer temporality allows to bring to light continuities, to question the nature of the breaks (e.g., in the styles, the objectives and the central actors) and more generally to offer elements for reflection to those who make the day-to-day life and evolution of science centres or museums,

1. Bernadette Bensaude-Vincent, « La culture scientifique et technique : une histoire à écrire », in Philippe Poirrier (dir.), *Histoire de la culture scientifique en France. Institutions et acteurs*, Dijon, Editions Universitaires de Dijon, 2016, p. 139-142. It is precisely because in French, *culture scientifique* designates a very precise reality, both historically and culturaly—very different from the English scientific culture. This is why I decided to keep the French locution throughout the text.

and of the many initiatives recognizing themselves as part of the ever-changing network of the *culture scientifique.*

In the following lines, I will give just an illustration by focusing on two moments of an extended history of the *culture scientifique et technique* in France, going back to moments when this terminology was not yet in use. Throughout this history, the commitment of the public authorities (at first national, then increasingly regional or European) in the promotion and the development of the *culture scientifique et technique* appears as a key factor.

Early signs arose just after World War II. At the end of the fifties, right at a time when the French research system was being rebuilt, a number of persons close to the emerging research administration expressed their concerns on the need to develop what was not yet called (it would come 20 to 30 years later) *culture scientifique.*[2] It was first of all a question of reconstructing the country. Of course, a material reconstruction (to restore infrastructures and industry), but also a symbolic one: restoring France in its leading position. For that purpose, numerous scientists, politicians and educators agreed on the urgent necessity to train more technicians, engineers and scientists.

It was therefore necessary to find them, and to convince them. Unexploited pools were soon identified: working classes and women. The means to reach them were readily found: new techniques, namely movies, records, radio and television. These were seen at the time as the best way to reach the younger generations, especially girls, and thus to successfully persuade them to enter scientific careers. They were also regarded as valuable tools for the continuing education: that of workers so that they could become technicians, of technicians so that they could become engineers.

2. For a more precise description, I take the liberty to refer to Andrée Bergeron, "From databases to "information for the general public": the long path toward the emergence of a public action for scientific popularization in France at the turn of the 70's", in Muriel Le Roux (dir.) *Communicating science*, PIE Peter Lang, Bruxelles, forthcoming.

Let us underscore just two points. First, the emphasis put on the importance to give rise to vocations (of technicians, engineers and scientists, for the industry and for the greatness of the nation), and even the special address to the girls appear as anything but new phenomena. Second, in the same way as is currently the case with digital technologies, those who wished to make science public showed an undeniable propensity to seize new tools at their disposal and to claim their use of these new technologies. Modern means for an always-modern object, so to speak—or the technological innovation to acculturate techno-scientific innovation.

The political and scientific mobilization on these questions prevailed for some time, pending the implementation of the necessary structures. It disappeared when the public authorities, being centred on other priorities, lost their interest on this matter.

The next decade saw the emergence, in institutions born out of the cultural decentralization (*Maisons de la culture*), of a new kind of activity: the scientific cultural action. According to André Malraux's plan, the *Maisons de la culture* had indeed opened on multi-purpose projects which, most of the time, took science into account: it was the case in Le Havre, in Bourges, Reims, Nanterre, Châlon-sur-Saône, Saint-Etienne, and in particular in Grenoble, where the first *Centre de culture scientifique, technique et industrielle* (CCSTI, Centre of scientific, technical and industrial culture) opened in 1979. The presence in the *Maisons de la culture* of what was simply regarded there as "another aspect of the cultural life" responding to both the wish of the scientific actors, concerned not to be cut off from the population, and the demand of the administration of the culture, which applied Malraux's doctrine based on his universalistic conception of the culture.[3] These activities were far from marginal. They not only attracted a large audience (300 000 entries in five years in Grenoble) but they also induced the constitution of an organized network: the *Groupe de*

3. On the French cultural policies for the period 1959-1973, see Philippe Urfalino, *L'invention de la politique culturelle*, Paris, La Documentation française, 1996.

liaison pour l'action culturelle scientifique (GLACS, Liaison group for scientific cultural action), created in the wake of a conference organized in 1974 at the *Maison de la culture* of Grenoble on the subject of the place given to sciences in the cultural action. GLACS initiated the flagship popularization activities for this period: *Sciences* (physics, astronomy, limnology) *in the city,* whose first edition, known as Aix-Pop, took place in the streets of Aix-en-Provence during a Physics Conference in 1973.

In view of this presence of scientific activities in the cultural institutions, from the very beginning and to the satisfaction of everyone involved, one could wonder why the idea of a regrettable absence of consideration of the sciences in the "culture" had such a great resonance. Quite the contrary: the history of Grenoble CCSTI teaches us that the CCSTI witnesses the scientists' need for the distinctiveness of scientific topics than a lack of awareness of the cultural institutions about science.

The rest of the story, at the beginning of the eighties, is known. Multiform commitments in the seventies (let us quote the science shops, the criticism of science, the development of scientific counter-expertise serving the protest movements and of course the scientific cultural action)[4] formed the compost on which the *culture scientifique* movement was built. The renewed interest of the administration, urged to implement the willingness of the minister,[5] made its emergence (under a still unstable denomination), and then its institutionalization, possible. Over these almost four decades, the *culture scientifique* movement in France adapted to multiple changes affecting its tools as well, as

4. On the science shops see Renaud Debailly, « Dans le giron de la vulgarisation : L'histoire des Boutique de Sciences en France », in Philippe Poirier (dir.), *L'histoire de la culture scientifique en France*, Dijon, Presses Universitaires de Dijon, pp 109-120; on the criticism of science see Renaud Debailly, La critique de la science depuis 1968, Paris, Hermann, 2015; on the counter-expertises see Sezin Topçu, *La France nucléaire. L'art de gouverner une technologie contestée*, Paris, Seuil, 2013.

5. Petitjean P (1998) La critique des sciences en France, in Baudouin Jurdant (dir.) Impostures scientifiques. Les malentendus de l'affaire Sokal. Paris/Nice: Alliage/La Découverte, pp. 118–133.

the objectives that were assigned to it, the authorities that assigned them to it and the society in which it fitted.

Obviously, the "participative turn" is one of these. Does it sign the end of the *culture scientifique* movement or does it just correspond to one of its many transformations? I consider the question to deserve further examination.

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FRANCE

Communicating social sciences

Joëlle Le Marec

For a long time, science culture was associated with the limited field of physical and biological science — sciences that heavily relied on mathematics and instruments. By comparison, the social sciences and humanities were always implicitly considered part of culture and for this reason were thought not to require specifics attempts at translation, vulgarization and communication. Moreover, social sciences texts (articles and especially books) are regularly accused of being overly dry, full of jargon, while the extreme difficulty in understanding an article in physics or biology is taken for granted: it is this evidence that prompted the need for vulgarization, understood as a translation. By comparison, social sciences are assumed to be naturally easier to understand as long as authors and readers alike display some good will.

With the accelerated development that Europe has known since the 2000s in financing research based on projects and economic, social and political policies (health and aging, sustainable development, digitization process, knowledge economy), multidisciplinarity and valorization are now official requirements when submitting a research proposal or a funding application. The merging of universities in France today further radicalizes this trend.

The systematic organization of collaborations between the natural and social sciences is regularly posited as a necessity in project-based research on socio-scientific topics. However, research-managers do not feel the need to understand social science work on value systems, social relationships (powers, legitimacy) or the models of the relationship between knowledges and democracy. Everyone involved in management or politics feels competent in matters of public opinion, the operation of mass media, social practices, heritage.

Social sciences and humanities are not acknowledged for their reflexive and critical dimension (and the concepts on which rest these critical questions), but, rather, are mobilized, on the one hand, for their methodological expertise (e.g., survey practices) and, on the other hand, for their capacity to produce discourses and arguments. For example, 'social acceptability' is less a concept than a governance tool, inspired by management practices that are transposed to social sciences when projects that will have a profound impact upon the lives of individuals and communities are carried out. However, it is often expected of social sciences to modify their epistemology to adapt themselves to the need to be objective, to measure, and to produce models to facilitate their collaboration with physical and biological sciences. For example, they are expected to provide numerical indicators of positions or trends, such as the perception of the quality of the environment.

We thus face a contradiction: social sciences are expected to contribute to multidisciplinary projects with specific topics geared to provide answers to questions of a sociopolitical nature. And yet they are encouraged to forgo the effort to easily share and discuss them, to adopt formalisms and the language of mathematization and modelization. Mathematization and modelization are even posited to be the condition of a reinforced 'usefulness.'[1]

1. We are almost in opposition to the theses developed by Baudoin Jurdant during

One of the roots of this paradox may be the displacement of legitimacies which transforms the needs of understanding in social science research, on the one hand, in terms of technical performances (measures and models of social phenomena), and, on the other hand, in terms of efficient communication (production of arguments and representations). What is the cause of this displacement of legitimacies and why is it not discussed when it is the role of science communication to develop a citizen reflection on sciences in society?

New actors have entered the game of dialogues and relationships that stimulates the production of scientific knowledges: engineering managers. They intervene at all levels: policy making and research administration, projects and programs management, forecasting, evaluation, communication. This sphere of engineering stems, at least partially, from the development of issues specific to the production of instruments, issues that have gained autonomy[2] (such as machines, procedures and protocols that are related to social engineering, with its own market, competencies, objects and spaces). These instruments have structured the physical and natural sciences to the point that they have become partially synonymous, and have become the very 'image' of their scientific legitimacy. Engineering in physical and natural sciences remain barely visible, because it is closely integrated to research environments and practices. We must nonetheless recall that the 'sciences, technologies and society' field was formed at the end of the 1960s and during the 1970s, when a critical view of the technosciences was seen as a necessity for a

his career. He considers the social sciences and humanities as an instance of reflexivity for the sciences, guaranteeing their continuing debatable and living nature. He unceasingly pointed to the necessity for sciences to enter a dialogue, to open itself to the questions and interests of those who share an interest in them but from a different standpoint than that of professional researchers. See Jurdant Baudoin (discussion with Joëlle Le Marec, 2006, "Écriture, Réflexivité, scientificité," *Sciences de la société*, No. 67, p. 131–144).

2. See Grossetti, Michel and Louis-Jean Boë, 2008, "Sciences humaines et recherche instrumentale: qui instrumente qui? L'exemple du passage de la phonétique à la communication parlée," *Revue d'anthropologie des connaissances*, Vol. 2, No. 1, p. 97–114.

number of the most important actors of this new field of reflection upon the sciences[3]. In social sciences and humanities, it is the very important development of devices designed to frame reading and writing practices and delegate the power to decide and govern writing conditions to 'architexts', often computerized models[4], that inaugurated in the 2000s a period of heavy reliance upon research instruments through a very discreet engineering in the cause of the optimization of the standardized production logic.

Thus, the computerization and 'plateformization' of value-adding activities (especially the activities of scientists) imprison sciences in frameworks that professional researchers can question only with difficulty: collaborate to produce, produce to develop a market economy. Research is less an autonomous intellectual activity than a sector presided over by powers that hide being the 'modesty' of an optimization drive.

In this context, there must be something better to do than for the actors of science communication to willfully enter these research promotion and management devices which lead the field to rapidly lose its reflexive capacities and its autonomy. Research management is barely questioned by science communication. The risk is genuine that powers gain ground outside the purview of the field of investigation of social sciences and humanities, and thus outside a necessary research on social functioning and their underlying ideologies. For example, it seems to me that the actors of science communication can reinvigorate questions on scientific collaborations without limiting themselves to an approach that rely strictly on instruments. Furthermore, a great number of individuals and groups are involved in knowledge practices

3. We naturally think of Jean-Marc Lévy-Leblond, Alexandre Grothendieck, Pierre Clément, and the numerous militants of a self-criticism of sciences and of a critical alternative press. See especially Igor Babou and Joëlle Le Marec, "La presse alternative de critique des sciences des années soixante-dix et les études de sciences contemporaines: inspirations politiques et construction académique," in Joëlle Le Marec and Mimmo Pucciarelli (eds.), 2013, *La presse alternative: entre la culture d'émancipation et les chemins de l'utopie*, Lyon: Atelier de Création libertaire.

4. See the seminal article by Yves Jeanneret and Emmanuel Souchier, 1999, "Pour une poétique de l'écrit d'écran," *Xoana*, Nos. 6–7.

without being professionals. These inconspicuous collaborations partially escape research management. They are in practice forums for questions, discussions and practices that develop outside economic imperatives and in the name of a political and cognitive requirement inspiring countless local innovations.

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GERMANY

New dawn for citizen science in Germany

Susanne Hecker, Anett Richter, Aletta Bonn

Citizen Science ist eine wunderbare Möglichkeit, gemeinsam nach Antworten auf gesellschaftsrelevante Fragestellungen zu suchen.

(Citizen Science is a wonderful opportunity to jointly seek answers to the many societal relevant questions and challenges we face today.)

Anonymous comment, online consultation *Greenpaper Citizen Science Strategy for Germany 2020*

Citizen science is a rapidly expanding field involving alternative models of public knowledge co-production and participation in science. This includes strengthening the scientific research innovation potential by engaging with a variety of knowledge domains and introducing new perspectives and information as well as new partnerships.

We understand citizen science as the engagement of people in scientific processes who are not tied to institutions in that field of science. Participation can range from the short-term collection of data to the intensive use of leisure time to delve deeper into a research topic together with scientists and/or other volunteers (Bonn et al., 2016).

There is a long tradition of voluntary work for ecosystem research where people engage in projects, share their expertise and knowledge in learned societies or one of the associations at local, regional or even national level. The novelty in citizen science for the formerly called amateurs or lay people is the affordable application of technical advancements such as mobile devices and smart sensors that can be employed to map, record, analyze and communicate scientific data and information. Citizen science strengthens science not only through increased data collection but also through the use of additional and different knowledge and capacities in society. In this way, new visions, information and insights as well as new partnerships are introduced and developed.

Citizen science is currently widely discussed within the scientific community and is becoming gradually accepted as appropriate research approach to specific research questions and scientific demands. Thousands of scientific projects are involving millions of citizens investing a huge amount of time and energy in actively participating in research supported by new technologies (Bonney et al., 2014).

The conditions for the development of citizen science in Germany are favourable. Citizens declare their wish to participate actively in scientific research and to be included in policy issue framing and decision making (Wissenschaftsbarometer 2016). One-third of German citizens already engage in voluntary work, i.e., more than 30 million people work regularly in schools, sports or nature conservation. People, however, seem to be less interested in getting engaged over a longer period in specialized organizations or other long-term commitments. Some rather choose to engage in projects for a shorter period. Volunteers in Germany wish to be recognized and valued more for the essential work they contribute. Often, these activities are scattered and little visible to members of the scientific community as well as to members of society. Citizen science offers chances for both citizens and scientists to collaborate for mutual benefit. In academia, citizen science is also widely discussed, especially with regards

to legitimacy as a valid approach in science. Scientists engaging with society often do not feel acknowledged and citizen science activities may even be seen counterproductive to their scientific career.

Internationally, capacity building for citizen science is realized in various forms. The institutionalization of citizen science through practitioner organizations in the United States, Europe and Australia indicates the need for capacity building for citizen science at national and international levels (Göbel et al., 2016; Storksdieck et al., 2016). One of the first targets to meet is to highlight and network existing projects and structures and to evaluate further need to develop citizen science.

In Germany, a two-year citizen science capacity-building program was implemented in 2014–2016 to assess potentials and challenges for citizen science.

Greenpaper on Citizen Science Strategy 2020 for Germany

The Citizens Create Knowledge (GEWISS) capacity-building program was a joint project of the Helmholtz Centre for Environmental Research UFZ/ German Centre for Integrative biodiversity Research (iDiv) Halle-Jena-Leipzig and the Museum für Naturkunde Berlin created by a consortium of scientific institutions and partners and supported by an advisory board with members from the media, social science and NGOs. The project was funded by the German Federal Ministry of Education and Research (BMBF). A key element of the project was the development and implementation of a series of dialogue workshops between different institutions and people to develop new partnerships and develop joint strategies for a German Citizen Science program. We invited researchers from all fields, citizens, civil society organizations, and scientific institutions to contribute their ideas and experiences to the enhancement of citizen science. In addition, we developed resources such as a citizen science film and a guide to foster the understanding of how citizen science is put into practice and how science, society and policy can benefit from improved capacities for citizen science in Germany. The final output of the program was the launch of the *Greenpaper Citizen Science Strategy 2020 for Germany*, which anchors citizen science as an important pillar in the future at the interface of science, society and politics. The development process was iterative, participatory and open to all. The *Greenpaper* reflects on the needs and demands to successfully implement citizen science in Germany and develops three fields of actions in science, society and policy.

In a first step, we collated information on the opportunities and challenges for citizen science in Germany during the dialogue forums that we organized together with hosts from all over Germany. Over 700 participants from 350 organizations from society, citizen science projects, research institutions and funding bodies provided input in the more than 20 events at the national scale. The second step involved the drafting of the strategy based on ten resulting reports of the events and a consultative process by both the advisory board and the GEWISS consortium. In a third step, we launched a four-week, moderated public online consultation process which frequented 1,000 users with more than 400 comments on the text to ensure the relevance of this strategic document. In addition, we received 53 consolidated written position papers from organizations from research, universities, citizen science projects, media and learned societies. During a final step, all comments were evaluated and synthesized for developing the final strategy. After a one-year joint effort we presented the *Greenpaper* to the German government. The strategy contains three core fields identified as fundamental to the development of Citizen Science in Germany. These fields encompass the strengthening, establishment and integration of Citizen Science into science, society and policy (Bonn et al., 2016). Several options for action are identified that will now need to be translated into action plans. Here, we expect that civil society organizations and individual citizens, scientists, government, as well as private funding organizations and politicians become more engaged in fostering citizen science and further develop frameworks and roadmaps

to action. Based in part on the *Greenpaper* recommendations, the ministry launched a new funding scheme for citizen science projects to foster the citizen science landscape in Germany and to further develop citizen science as an integrated approach for bridging science and society in summer 2016.

First international ECSA Conference 2016 in Berlin, Germany

Hosted by the Citizen create knowledge GEWISS project, the first European Citizen Science Association (ECSA) international conference took place in Berlin on 19–21 May 2016 at the Kulturbrauerei (www.ecsa2016.eu). The aim of the conference was to discuss the innovation potential of citizen science for open science, society and policy. In total, 368 participants from 30 countries attended the three-day conference as well as members of the Berlin public during the ThinkCamp and citizen science fest. The programme sessions and interactive formats allowed for 107 talks, 99 posters, four discussion forums, a vibrant dance during the citizen science disco, a citizen science fest, two field trips and 546 tweets.

The conference provided a dynamic, lively and transdisciplinary atmosphere with various formats and plenty of networking opportunities. The conference was organized by the Helmholtz Centre for Environmental Research – UFZ, the German Centre for Integrative Biodiversity Research (iDiv) and supported by 19 international funding partners and the German Research Foundation (DFG).

Our visions for citizen science

The development of the citizen science strategy in Germany led to a joint vision for citizen science in Germany. This vision encompasses three major fields of:

1. Strengthening existing structures and framework conditions for the participation of citizens in scientific processes.

2. Building new infrastructures.
3. Integrating existing structures and procedures into society, science, technology, media, education and policy to unleash the full potential of citizen science.

Successful and satisfactory participation in science is achieved through the recognition and appreciation of those who are part of citizen science, including citizen scientists and the researchers involved in scientific institutions. Coordinators and initiators of citizen science activities are pivotal for citizen science in practice and act as important intermediaries between the science and society world. Their role has so far been inadequately appreciated and further emphasis needs to be placed on measures of esteem for all contributors. Comprehensive data quality management and the development of data protection and associated legal issues are further challenges to be tackled. Technical advancements in data management such as the establishment of natural history atlases and structural improvements in the scientific system such as the implementation of open science in research institutions also enable the necessary flexibility and successful implementation of active co-design and co-production in citizen science. Important are also the provision of long-term financial and staff resources to support the growing citizen science community, paired with effective internal and external communication.

We strongly believe that citizen science provides great opportunities to jointly meet challenges of societal relevance and scientific endeavour. Whilst citizen science is expected to raise scientific literacy for citizens, engaging with the community also means learning potential for scientists as well as innovation potential for science and society.

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INDIA

Probing the cultural distance between science and the public

Gauhar Raza, Surjit Singh

With scientific endeavours throwing up fundamental, intriguing and often-ethical issues and technology making deep inroads in society, an understanding of science and technology among the civil society has gained exceedingly more traction today than ever. The rapid and ever increasing pace over the past half a century has truly "tended to make science circle around the public" (Fayyard, 1994).

Despite the claim made by many that science is 'public knowledge' and scientific community is an ideal open society, non-scientists do not experience falsifiability of scientific knowledge or a supposedly democratic character of science (Golinski, 1998). More often than not it is the scientific information generated and the *do's* and *don'ts* prescribed by the community of experts that permeate among the 'public.'

To the public at large science and technology is projected as a problem solver. In reference to an OECD conference Claudie Haignere raises the concern, succinctly, "… scientist brings his or her expertise; and policymaker makes a decision and takes action.

But what about the rest of the population?" (Claudie Haignere, 2013, 39–40,). This is the question that constitutes the core of research on public understanding of science.

Defining scientific literacy

Many researchers tried to define 'scientific literacy,' yet the term has defied a precise definition since it was introduced in the late 1950s (Hurd, 1958; McCurdy, 1958; Rockefeller Brothers Fund, 1958). Although it is widely claimed to be a desired outcome of science education, not everyone agrees what that means. The problem is magnified manifold when scientific literacy becomes the objective of science education.

There are a number of reasons for this indefinability. Most important is the fact that scientific literacy is a broad concept encompassing many historically significant educational themes that have shifted over time. Some writers have even admitted that it may be no more than a useful slogan to rally educators to support more and better science teaching (Bybee, 1997).

It is also argued that instead of defining scientific literacy in terms of specifically prescribed learning outcomes, scientific literacy should be conceptualized broadly enough to pursue the goals. This would do more to enhance the public's understanding and appreciation of science than will current efforts that are too narrowly aimed at increasing scores on international tests of science knowledge (DeBoer, 2000).

International efforts in public understanding of science

In the initial stages, Jon D. Miller conceptualized the notion of scientific literacy and its importance in a democratic society. Miller argued that higher levels of 'scientific literacy' are essential to foster informed and intelligent participation in science policy issues which will improve the quality of science and technology and people's life (J.D. Miller, 1983).

Survey studies carried out during the initial phase on what was called 'scientific literacy' (and the term has arrogant connotations) have been criticized for their myopic view of people's structure of thought (S. Miller, 2001; Raza et al., 2002; Bauer et al., 2007). These studies aimed at categorizing people into 'scientifically literate' and 'scientifically illiterate',[1] and develop national index for scientific literacy, which could be used for international comparison (Zhongliang, 1991).

Though the initial efforts in the West have left a deep influence on present-day survey studies, most scholars rejected the framework by the mid-nineties (Baranger and Schiele, 2013, 29). 'Scientific literacy' or 'deficit' model of analysis—Eurocentric, simple and addictive as it is—has not been replaced by any other universally acceptable analytical framework. However, the demise of the 'deficit model' unleashed the possibility of many other conceptual and analytical models for probing the public understanding of science.

Indian experience

In India, investigation into people's understanding of science was an offshoot of a widespread pan-India civil society-driven science movement, it had different concerns, which determined the broad research objectives (Raza et al., 1991). The People's Science Movement, a conglomerate of many civil society organizations, with the participation of thousands of volunteers, aimed at reaching modern science to the lay publics in India (Bharat Jan Gyan Vigyan Jath, 2004).

The framework, methodology and indicators developed by western scholars could not be applied to probe the people's structure of thought in India. The American and Euro-centric instruments of investigation had two serious lacuna. Firstly, these could be used, at best, for carrying out cross-regional and cross-

1. This categorization in another context is termed as 'savants' and 'ignorants' by Bernadette Bensaude-Vincent (2013, 104).

national comparative analysis and, secondly, they did not provide any insight for propagating science to the lay public.

In India, the broad objective of research—reaching out to the lay public—determined the conceptual model and thus following decades witnessed the development of instruments for measuring people's understanding of science, perfecting the methodology of field surveys for Indian conditions and analysis of significant indicators.[2]

Questions such as why certain scientific ideas, created in laboratories, get propagated comparatively faster than others and become part of people's thought complex or what role formal education, gender, occupation, play in determining the propagation of science to the lay public were not prime concern of researchers in the West.

The basic research questions that we asked were: 1) Who do we focus on, those who are so called scientifically literate or those who could be declared as scientifically illiterate? 2) Do we consider an individual as a unit of analysis or is it the response to a question that should be the focus of the study? 3) Why do certain scientific tenets, laws and information elicit high percentage of scientifically correct responses from a given set of cultural sub-group?

Answers to the first question led us to the understanding that no citizen could be designated as 'scientifically illiterate.' A farmer who has never been exposed to modern education and science uses accumulated experiential knowledge and relies upon scientific methods while performing his agrarian daily tasks, even if she or he relies on superstitious and rituals in other domains of life.

To probe the thought structure of the public it was decided that the unit of analysis should be response. Thus, the second question led us to develop categories of responses instead of individual respondents.

2. The studies carried out by the team during Kumbh Mela 1989, Ardh Kumbh, 1995; Kumbh Mela, 2001; Ardh Kumbh, 2007; and Kumbh Mela, 2013 took a trajectory that was quite different from the earlier studies.

To achieve the objective of communicating science to the public effectively, it would have been a futile exercise to measure what percentage of respondents gave scientifically correct answers. Such conclusions could not have helped in developing the strategies for increasing the efficacy of science communication in the country. It was important to develop a scale on which responses could be mapped and statistical analysis.

For this four categories of responses were developed. These categories were 'scientifically correct,' 'scientifically incorrect,' 'extra scientific' and 'don't know.' The scale so constructed, when used for mapping the responses, had scientific explanation on the one end and cognitive gap[3] on the other end.

The third question led to refining the framework for probing the thought structure of the public. It was apparent from the literature available that some of the demographic parameters such as education, gender, and exposure to media channels were strong determinants of public understanding of science. However, the percentage of scientifically correct answers rendered by a target group changed quite substantially across the indicators chosen for the investigation.

Much later, Chinese scholars who developed the 'difficulty index' for each indicator provided a simplistic answer to this observed pattern. Under the influence of the deficit model, the Chinese team, which carried out the scientific literacy surveys, did not probe the causal relationship between nature of scientific information and the percentage of correct answers rendered by a given populace (Ren and Zhai, 2013).

3. 'Don't know' response for the analysis indicated cognitive gap needed to be filled with scientific explanations. It was argued that this gap, was created by the loss of traditional, at time mythical explanations, cannot remain unfilled for long. If science communicators do not communicate scientific explanations, the gap will be soon replaced with the anti-science forces, which we have witnessed in many other societies.

People, science and cultural distance

In India, realizing the importance of people's culture as a strong determinant of thought structures of a common citizen, the research took a different direction. It was amply clear, even at the initial stages of research, that the scientific ideas are produced, refined and filtered in a culture before these are communicated to the public. The scientific method of configuring material reality is far removed from people's culture. In other words, there exists a cultural distance between science and the public. Thus, the question as to why certain scientific facts and explanations to natural phenomena are absorbed within the public's structure of thought, with lesser efforts and at a faster pace compared to other scientific explanations, led us to the 'Cultural Distance Model.'

Curiously, it was observed that a cultural distance separated the 'people's cultural thought structure' and the 'scientific methods of configuring reality.' This cultural distance was determined by factors that could be categorized as extrinsic and intrinsic to scientific knowledge under scrutiny. All demographic factors such as education level, age, occupation, gender, and exposure to information channels, are extrinsic to scientific information, yet these factors impinged on or accentuated propagation of scientific information.

The intrinsic factors that control the cultural distance of a scientific phenomenon were 'life cycle of the phenomenon,' 'the control that an individual or group could exercise,' 'the conceptual and mathematical skewness involved in explaining the phenomenon' and 'the intensity with which the phenomenon intervenes in the life of the group under scrutiny.'

With this framework, quite clearly, each piece of scientific information and explanation selected as indicator for probing the public understanding of science could be placed at a specific cultural distance from people's thought structure (Raza and Singh, 2004) of ours which give cultural distance). The mapping of scientific ideas on a 'cultural distance scale' has clearly shown that all scientific ideas and information cannot be communicated to various cultural groups using the same methodology. This mapping helps in devising effective strategies for communicating science to a specific cultural group or sub-group.

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NORWAY

The Nordic model of science communication

Per Hetland

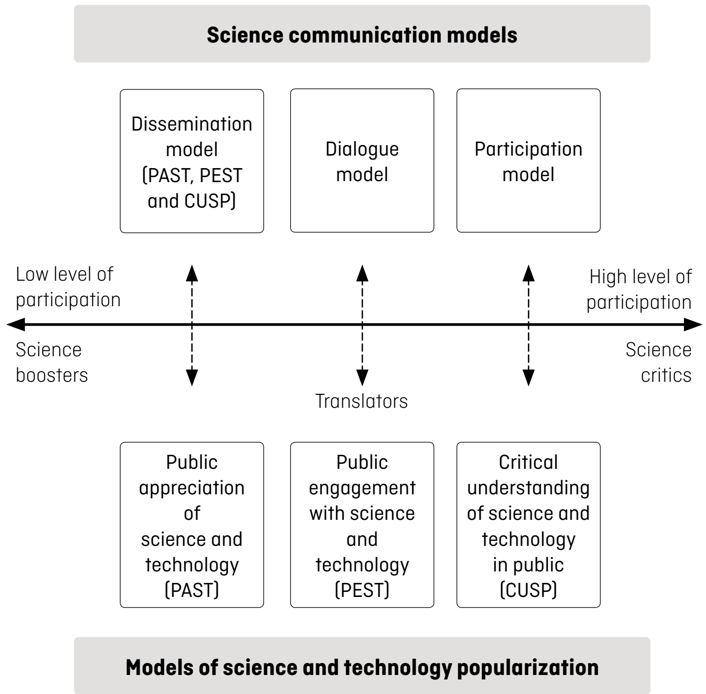
Science, technology and public enlightenment are crucial elements of the modern project. As a forerunner of the modern project, academia includes education, scientific research, and the public communication of science and technology (PCST) as its three most prominent assignments. Widely diverse publics engage in popularized science, but they are also involved in doing science, giving direct or indirect feedback and facilitating a variety of communication forms with many possible outcomes including upstream and/or downstream mediating processes, knowledge dialogues, or building new knowledge. Consequently, the ecosystem of PCST may be studied along many dimensions. This chapter synthesizes six exploratory case studies of Norwegian PCST combined with a comparative mixed-methods study. One overall aim of the chapter is to contribute to a more analytical approach to studying the different science communication models as development zones in the context of the *Nordic model of science communication* (NMSC), as science communication is always culturally situated.

The ecosystem of Norwegian science communication

One important aspect of the ecological approach is to uncover the multiple viewpoints that have enriched the debate over PCST in recent decades, as there has been an increased focus on, first, how different models of expert–public interaction frame public involvement, and second, how different models of science and technology popularization frame science and technology narratives (Davies and Horst, 2016; Hetland, 2016b). Three key models of expert–public interaction are central to PCST, as follows: the dissemination, dialogue and participation models. The totality of the three key models is important in terms of how each has developed over time. Science and technology popularization is an important part of the dissemination model, and Perrault (2013) identifies the three following sub-models of science and technology popularization: public appreciation of science and technology (PAST), public engagement with science and technology (PEST), and critical understanding of science in the public (CUSP; Perrault, 2013, 12–17). The relationship between the three models of expert–public interaction and the three sub-models of science and technology popularization are illustrated in Figure 1.

Science communication has been an active part of Norwegian science and technology policy since 1975. Since this time, concerns with public engagement have led to a mode that is more dialogical across the three models within science and technology communication policy in Norway (Hetland, 2014). Through an active policy, sponsored hybrid forums that encourage participation have gradually been developed. In addition, social media increasingly allow for spontaneous public involvement in a growing number of hybrid forums. Dialogue and participation have thus become crucial parts of science and technology communication, thereby shaping public engagement and expertise. However, it is still important to study how PCST is actually performed in the PAST sub-model, wherein it is promoted by science and technology boosterism and

Figure 1 • **The ecosystem of science communication**



consequently exhibits a strong *pro-innovation bias* (Hetland, 2015). Studying the narratives envisioning new technology, PCST also contributes to public engagement and the domestication of this technology, with some journalists taking the role as translators (Hetland, 2012). When journalists popularize a highly topical new technology, they situate their popularization within technological expectations; in contrast, when researchers do so, they situate their popularization within a retrospective and prospective understanding of technological change. Following this, journalists are inclined to appeal to emotionally involved users or pioneers, while researchers are inclined to appeal to responsible citizens.

Hence, journalists immodestly dramatize the future by boosting a new technology or turning its risks into threats, while researchers act as "modest witnesses" (Haraway, 1997), taking the role of science critics and indicating skepticism about the journalistic approach (Hetland, 2016a).

Studying the dialogic model, it is crucial to probe the room for dialogue. This is structured along two axes—the intensity of participation in knowledge and policy-construction processes (Hetland, 2011b). The more opportunities users have to play out authoring, positionality and improvisation (Rasmussen, 2005), the more included they are in the transformation process from the experimental phase to policy and practice. Finally, the participation model is considered through a case study of Citizen Science and important processes in building boundary infrastructures, which facilitate collaboration between scientists, amateurs/volunteers, and administrators across disciplines and organizational boundaries (Hetland, 2011a).

The Nordic model of science communication

When reading about the deficit model, dialogue and participation are often promoted as a strategy to overcome this model's flaws. However, as solutions, dialogue and participation are not without problems. Consequently, it is necessary to critically examine these two models as well. What do dialogue and participation actually imply?

By focusing on Norway and the models as development zones, I claim that one sees the contours of an NMSC. Science communication research (SCR) in the Nordic countries is strongly influenced by the Anglo-American tradition. However, I also claim that there is a specific NMSC that is often overlooked in SCR. This NMSC rests on four pillars, as described below.

First, science communication is always understood broadly, including the social sciences and humanities (Hetland, 2014). Consequently, in the Norwegian language, *science* communication translates into *research* communication, with a similar meaning to

the German word "Wissenschaft," which include humanities and social sciences (Davies and Horst, 2016). Science and technology communication is also sometimes called the third assignment, and it should accomplish the following: 1) contribute to PCST; 2) contribute to innovation; and 3) ensure the participation of higher education staff in public debate. One important condition for undertaking the third assignment is academic freedom (Underdal et al., 2006), and from 2007, this has been included in the Act Relating to Universities and University Colleges. Since 1990, Norwegian National Research Ethics Committees have given advice on research ethics, and according to the Norwegian *Guidelines for Research Ethics in the Social Sciences, Law and the Humanities* (NESH, 2006):

> Science communication involves communicating insights, ways of working and attitudes (the ethos of science) from specialized fields of research to individuals outside the field ('popularization'), including contributions to social debates based on scientific reasoning… Communication is also an expression of one of the requirements for democracy: Communication shall contribute to the maintenance and development of cultural traditions, to the informed formation of public opinion and to the dissemination of socially relevant knowledge (p. 32–33).

Studies of Norwegian PCST for the period of 1998–2000 have estimated that each university faculty member wrote an average of 2.1 self-reported popular articles and made 1.4 self-reported contributions to public debate (Kyvik, 2005).

Second, PCST has been understood as a crucial part of a long-standing, unwritten social contract between science and society. In Norway, this social contract has increasingly been made explicit and written, for instance, in the laws governing higher education institutions in Norway. This was first done in the law governing the University of Bergen (1948), followed by the revised law governing the University of Oslo (1955), the law governing all public higher-education institutions (1995), the revised law governing both public and private higher-education institutions (2005), and finally, the expanded and strengthened 2013 Act Relating to Universities and University Colleges, which declared that higher education institutions have three assignments: education, scientific research, and science and technology communication. The concept of the third assignment underlines the strong contractual element; one may claim that it represents a constitutional moment. This contractual element is emerging as a crucial element of the Nordic welfare societies, emphasizing free access to higher education (Christensen, Gornitzka and Maassen, 2014), which includes easy access to the benefits of scientific research (Hetland, 2014).

Third, in Norway, PCST has its historic roots in the Danish-Norwegian Enlightenment tradition from the late 1600s and early 1700s (Engelstad et al., 1998). The third assignment, therefore, has been perceived as an important part of the Humboldt legacy of *Bildung,* or liberal education and civic character formation (Kalleberg, 2011). Kalleberg (2012) draws a clear distinction between two academic roles as follows: "one as experts with *clients,* the other as public intellectuals with *citizens*" (p. 48, emphasis in original). Consequently, science communication in the Nordic countries builds on a long tradition of dialogue, irrespective of which science communication model is in play (Hetland, 2014; Horst, 2012; Kasperowski and Bragesjö, 2011). An important figure in this long tradition in Scandinavia is Danish-Norwegian professor Ludvig Holberg (1684–1754), who was deeply concerned with the emerging publics in the early Danish–Norwegian Enlightenment (Kalleberg 2008). This dialogue is clearly visible within the PEST and CUSP sub-models (Hetland, 2012; 2016a), as well as within the "deficit" or PAST model (Hetland, 2015). When it comes to the PAST model, one may claim that the attempt to achieve dialogue takes place in a context marked by Western society's strong pro-growth bias. Finally, dialogue is clearly the defining feature of the dialogue and participation models (Hetland, 2011b; 2011a), and the two studies partly map the room for dialogue and partly illustrate the importance of building boundary or knowledge

infrastructures, thereby facilitating bridging activities and co-exploration.

Fourth, the Media Welfare State emphasizes "*universal services*, *editorial freedom*, *a cultural policy for the media*; and last, but not least, a tendency to *choose policy solutions that are consensual and durable, based on consultation with both public and private stakeholders*" (Syvertsen, Enli, Mjøs and Moe, 2014, 2, emphasis in original). In relation to NMSC, the Media Welfare State is visible in several collaborative projects, such as forskning.no, forskning.se and videnskab.dk, just to mention three examples (Hetland, 2014). These three versions of online newspapers devoted to Scandinavian and international research are also extensively cited in local mass media. Consequently, free and universally available science communication is considered a foundation for an enlightened public.

In my claim, these four pillars are the core constitutional elements of NMSC. There are, of course, important variations between the Nordic countries; consequently, NMSC is an ideal type. However, it constitutes an important context for studying the science's new social contract with society.

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SOUTH AFRICA

Formulating a scientific culture in South Africa

Hester du Plessis

By definition the term science culture refers to the degree in which a society engages with science. It showcases a country's historical, social, cultural, linguistic, political and geographic environment and reflects the manner in which a government supports the institutional and academic development and adoption of science and technology for the good of its people. A science culture is showcased through the support of science shows, science museums and scientific research. Though science research is linked to global needs and problem solving, its local science culture adopts and adapts to aspects that are of importance to the country's specific needs.

To facilitate a healthy and balanced science culture by implication, a culturally homogenised society with a trusting and mutually respectful relationship between its government, its academics and the general public(s) is required. The question arises: what happens to a science culture that is manipulated to serve political needs—especially in a culturally complex multi-cultural society? To look deeper into this question, the ideological manipulative politics behind colonial rule could serve as a good example. Let us focus on the intellectual environment and subsequent manner in which the generation of ideas, the efforts of strict state control on information and a complex colonial past created a problematic space in the current, still underdeveloped, field of science communication in South Africa.

The general view is that science culture should not be seen as an activity separate from that of a society's cultural activities. In this context, cultural activities refer to everyday life as well as to the worldview of a society. Culture, however, is not a static entity and it is generally accepted that new ideas and new science findings are being filtered through multiple layers of cultural practices and worldviews before and until it becomes accepted by a society. In today's debates, concern is expressed about the colonial dominance of western science over that of localized citizen science—even if we know that historically the flow of modern scientific ideas from the west to the east was a gradual process that started as far back as in the seventeenth century. This concern, however, might be more based on the evidence that the introduction of new technologies to the colonized societies turned Africa into a living science laboratory; an action that formed the bedrock of British imperialism (Tilley, 1968; James, 2016).

The contextualization of science in a specific society is difficult, particularly if we maintain that there exists cognitive homologies that bridge knowledge forms across cultures and civilisations (Habib and Riana, 2007). In this regard, we need to keep in mind two main perspectives: the postcolonial perspective of science and the perspective from the sociology of scientific knowledge, with both perspectives looking at science from within a social context (Habib and Riana, 2007). Understanding the social history of science informs us of how a state, with a specific world view, uses science to serve a specific political purpose. It is within the entanglement between science and social values that the collusion between science and colonialism becomes noticeable. With the field of science communication acting as a social medium and playing a central role in both the cultivation of trust and the processing and advancing of new ideas within and between cultures, it requires

the maintenance of responsibility to speak the truth and to reflect reality as far as it is possible.

This is not to say that the domain of science communication itself is not complicated and, due to its transdisciplinary nature, complex and often unpredictable. Coupled with the discourse of transgression that characteristically questions dominant axioms and assumptions while exposing their contradictions, paradoxes and conflicts, a transdisciplinary approach to science communication, however, provides us with limited means to critique, re-imagine and reformulate the status quo (Klein, 2014). Science communication further provides space to question the politically favoured dominant forms of knowledge that has been marginalizing other knowledge systems, creating gaps between official, colonial and indigenous approaches, and between esoteric and organic knowledge (Baxi, 2000).

Nowhere is this more prominent than in the debate that is developing around the election of the TV reality show host Donald Trump as the Republican Party's choice as American President.[1] Questions are arising whether his election is proof that science communication has failed in its effort to ensure and stabilise a sound democracy.[2] The message coming strongly across is that (scientific) facts no longer matter and that we have created a culture of complacency in the scientific community with a long-standing reticence to confront the profound, dire problems we now face.[3] It is maybe time to learn from the past to be able to radicalize and use science communication as a socially responsible creator of a new vision. For too long, the political tendencies towards 'post-

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1. A case can be compiled against the long tradition of the Christian Fundamentalists in the United States who formed the Republican Party (RP). The RP deliberately created an alternative educational and media echo-system since the 1970s to support alternative facts to that of evidence based scientific research.

2. Tom Nichols, *How America lost faith in expertise and why that's a giant problem.* https://www.foreignaffairs.com/articles/united-states/2017-02-13/how-america-lost-faith-expertise (accessed 2017/02/20).

3. *Literacy of the present. Sci-Comm: what is to be done.* https://literacyofthepresent.wordpress.com/2017/01/24/sci-comm-what-is-to-be-done (accessed 2017/02/20).

truth' and the media as sub servant were allowed to lead the world into the situation where truth and scientifically proven reality are of little importance.[4] The rise of post-truth politics has been strategically supported by the proliferation of populist states with their privately owned media driving a selective political agenda. The social media (tweets) adds to this dilemma where users create 'echo-chambers' in which one politically biased viewpoint (often fuelled by post-truths that goes by the name of 'clickbaits') as post-factual truth pops up. The practitioners of post-truth are characterized by an emotionally repetitive inclination of speaking untruths and the danger of this lies in the warning coming from Robert Frisk[5] that "we are starting to live the lies of others."

Science communicators need to ask whether questioning the relevance of scientific findings precedes communicating the relevance of its findings within the wider public domain. We must ask: do we acknowledge the specific ideological prerogative of the state in its scientific research preferences? These questions raise the issue of the intellectual 'tradition' and epistemological integrity and preference of science in relation to the specific ideologically based governance mandate of the state.

In an Orwelian world designed by colonists and ruled by an emergent group of populist politicians, we need to take a hard look at the underpinning principles of science and society in Africa. There is no doubt that science communication is a means to bring truth, ethics, value, objectivity and subjectivity into the debate with all the complexities related to scientific method and geographical, political and cultural relevance (Blackburn, 2006). This is in an ideal world. Political reality says different.

Africa has a long and difficult colonial history marked by the use of 'scientific expertise' during conquest and colonialization.

4. The word "post-truth" is an adjective defined as: "relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief", *Oxford Dictionary*.

5. http://www.independent.co.uk/voices/donald-trump-post-truth-world-living-the-lies-of-others-a7500136.html (accessed 2017/01/24).

The British colonial period in South Africa (1795–1910) was a period whereby a system of social and epistemological segregation was established, unscientifically based on race and ethnicity. This provided opportunity to enforce a systemic and ideologically driven political agenda to enforce the colonizing of land and to put laws in place to enforce racially segregated education etc.[6]

The British established a platform by 1948 for white public discussions on matters of western society and science. These public discussions were hosted from by 1948 by the South African Library to cement mutual trust and regard amongst representatives of the intellectual, social and political white elites (Dubow, 2006). The discussions were by invitation only to the colonial white intelligentsia. It is against a politically created perception of 'darkness' and 'primitiveness' that the colonials felt empowered to progressively introduce the principles of modernity to Africa. The South African Association for the Advancement of Science (1905), the South African Institute for Medical Research (1912) and the Bernard Price Institute for Geophysical Research (1937) were instituted.

Within the exclusive white National Party and its Apartheid system (1948 to 1994) the promotion of modernity and pitting scientific rationality against local 'black primitivism,' continued to be institutionalized. All scientific institutions played a significant role in promoting the notion of science as epitome of (western) rationality. Since science was not considered as being overtly 'ideological,' it served the purpose of providing an easy conduit

6. In 1929, the president of the British and South African Associations for the Advancement of Science (BSAAS), Jan Hofmeyer, announced that "science must harness the great resources of Africa" and "overcome the might of African barbarism and the defiant resistance of African nature," thereby spelling out a politically manufactured and racially based 'post truth' to incentivize science research (Tilley, 1968). When the African Research Survey (1992–1993) was instituted, it had as purpose the intent to look at the extent to which modern knowledge was being applied to African problems (Tilley 1968). Lawrence James (2016) considered the colonial quest as having transformed the African into a biddable worker and consumer of foreign goods in the interminable struggle to conquer the 'mystery of darkest Africa' and access the wealth of minerals Africa possesses.

for transforming British colonial ideals to the Apartheid ideology of the National Party.[7]

It took thirty years to overthrow white supremacy in South Africa and during this time the state, in true 'post-truth' fashion, unscientifically used race as a social indicator of difference.[8] The intellectual tradition in South Africa after 1994 remains as mixed as its population and Peter Vale (2014:2) states that "… apartheid was a deeply divisive system—it literally encouraged the country's citizens to understand their histories in different (and often competing) ways. Its ending changed this: not only was apartheid's intellectual scaffolding in ruins but the everyday life of the system was wholly discredited."[9]

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7. Science communication was heavily censored under the Atomic Energy Act (1948) that regulated the uranium industry and allowed for the secret building of a research nuclear reactor. Any mention of information on atomic energy could only be published with official permission and the penalty for contravention was a fine of up to R10 000 (£5,000) or up to 20 years imprisonment, or both. (Ormond, 1985:193). The extent of the nuclear weapons program was only officially acknowledged after South Africa's accession to the Nuclear Non-Proliferation Treaty in 1991 (Steyn, 2003). This accession was followed by the voluntary dismantling of five 'nuclear bombs' just before 1994—providing the South African public a first glimpse of this 'shady' aspect of the apartheid South African science world (Steyn, 2003).

8. The 1994, the democratically elected African National Congress (ANC) adopted a National System of Innovation (NSI) as key concept in an effort to level the racial playing fields. At the core of the NSI, reflected in the South African Green Paper on S&T: *Preparing for the 21st Century* (1996), we encounter the urgency of communicating on matters related to science. Science research, however, is still struggling to overcome the legacy of what Paulin Hountondji (2002: 503) identifies as 'scientific extroversions' where African scholars "… remain pre-orientated in choosing their research topics and methods by the expectations of their potential public which then causes them to lock themselves up into an empirical description of the most peculiar features of their societies, without any consistent effort to interpret, elaborate on, or theorize about these features. In so doing, they implicitly agree to act as informants, though learned informants, for western science and scientists."

9. Liberalism in its consideration of the individual rather than the group as essential social subject found an important space within the white dominated Apartheid politics whereby some white politicians and intellectuals could favour a sympathetic attitude towards the black (oppressed) majority. Marxist theory and practice enjoyed support from the ranks of the black political struggle groups. The uniquely structured Afrikaners (originating from white European stock with an indigenised new language) took up positions on liberal nationalism, pluralist logic, political pluralism, the institutionalism of Dutch Calvinism; driven by a dualistic understanding of race and class and a hermeneutical-communitarian idea of the self. A strong positivist tradition of cultural pluralism is still maintaining invisible

After more than twenty years of democracy, the politically driven racial divide remains ever present and science communication is still trying to find a central role to do what it is doing best: speaking the truth in support of unbiased scientific evidence.

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threats of scientific pragmatism and empiricism. The strong presence of African Nationalism, the Pan Africanist movement as well as the Black Consciousness and the philosophy of Ubuntu is currently emerging as contenders for supporting a different kind of science culture—but this process is ongoing.

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UNITED KINGDOM

Trust in science after the BREXIT

Martin W. Bauer

The people of this country
have had enough of experts

— Michael Gove

Making science is a global affair, while science culture remains local. In an interview during the high time of the BREXIT campaign in June 2016, Michael Gove, a leading anti-Europe face and former Minister of Education, refused to name any economists (the science of economics) who backed Britain's exit from the European Union, saying that, "people in this country have had enough of experts." This statement was later widely taken as emblematic of the dire state of science in a post-BREXIT United Kingdom. Before joining the general lament (as in BBC *Newsnight,* 27 February 2017), let us examine some United Kingdom data on long-term trends in public opinion on science.

The long-term trends in the United Kingdom indicate increasing trust in science, increasing familiarity with science, stable evaluation of the utility and declining moral reservations about science, and a stable or receding general interest in science since 1990. This suggests that science has gained a mundane normality in everyday life in the United Kingdom. However, there are also potentially worrying counter-trends to keep an eye on .[1]

Increasing trust in scientists

IPSOS Mori publishes its 'veracity index' for the United Kingdom since the 1990s, asking annually whether people are thinking that various public actors are 'telling the truth.' Since 2000, a rising proportion of the public grants scientists veracity, increasing from 65% in 1997 to 85% in 2014 (+/-3%). This is a continuous and robust trend; it has declined slightly declined since 2014 to 80% post-Brexit in November 2016, probably not statistically significant.

The 'veracity' of other professions remained stable for 20 years, trust in United Kingdom institutions is not slipping. However, the clergy's credibility declined from 82% to still a high 70%. It looks as if what science gains, the Church is losing in public standing. Are scientists taking the role of the secular 'priesthood' in United Kingdom society?

It is not clear what explains the trend change setting in before 2016. Some of it might be a ceiling effect. It is difficult for more than 85% of the public to say they trust an actor; the United Kingdom is not North Korea. Also, it remains unclear whether these trends are homogenous across all segments of the public. MORI has yet to open up the data files to examine this question.

Increasing familiarity with science

Several indicators point to increasing familiarity with standard scientific facts. The 2014 BIS survey compares to an earlier British Social Attitude survey: in 1988 14% of the public got a set of difficult quiz items correct; in 2014, the same items are answered

1. An earlier and slightly longer version of these observations was submitted to the House of Commons Science and Technology Committee *Enquiry on Science Communication*, 29 April 2016.

correctly by 29%. The percentage of people who got all items wrong declined from 22% to 5%.

The Eurobarometer with nine quiz items confirms this increase: a continuous rise in mean familiarity scores for the United Kingdom since 1989 is observable across all generations; and the gradient is accelerated for Generation X (born 1963–1977) and for the Millennials (born after 1977).

Positive evaluation remains stable; moral reservations are declining

The British appreciate the utility of science, increasingly agreeing that "science will makes life easier and more comfortable" and "science will offer more opportunities for future generations." While these indicators can vary from year to year, the trend is stable (in Eurobarometer) or increasing (in BIS-MORI data) since the 1988.

Moral reservations such as "science and technology change our life too fast" and "we depend too much on science and not enough on faith" find less and less agreement. Compared to 1989, the British are less worried about science interfering with religion and have become impatient with the rate of change.

However, the generations do not move entirely in step. On the utility of science, the younger become even more positive, the older less positive (Eurobarometer 1989–2013). Reservations decline across all generation; while millennials are much more impatient than the other generation groups.

Decreasing interest and engagement with science

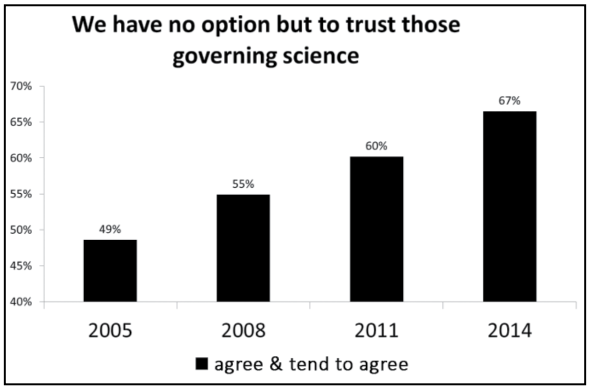
The index of interest in science remains stable over the years and so does the index of feeling informed. But the generations are not in step. Interest tends downward for the WWII generation; among Generation X it is increasing, but not so among Millennials. Generation X feel increasingly informed about science, less so the older. Millennials are remarkably more informed since 2005, but less interested, maybe because better informed.

These four long-term trends are juxtaposed by several shorter counter-trends: trust in scientists is expressed with a sense of resignation; the massive increase in media coverage peaks in 2007; and the mobilization of science into societal impact is accompanied by a 'mythical' image of science in public.

'Resigned trust' in the governance of science increases

The new series of British Attitudes to Science (BIS-BAS) shows a curious trend. In 2005, 49% agreed "we have **no option** but to trust those governing science," this increased continuously to 67% in 2014 (+/-2%). The increase is stronger among women than among men; stronger in Northern Ireland than in other regions; but not at all the case in Scotland. This trend of resigned trust in the governance of science is accentuated among the WWII generation and among Generation X, but less among Baby Boomer and Millennials.

Figure 1 • **The attitudes to governance of science, BIS-BAS 2005-2014**



At the same time, expectations remain high but shifting: Agreement on "those who regulate science need to communicate

with the public" remains at 90%. "The government should act in accordance with public concerns over science and technology" and "scientists should listen more what ordinary people think" receive 80% agreement, declining since 2005. Agreement to "people are sufficiently informed on decisions on science and technology" remains below 20%.

These trend items form an index of 'acquiescence with technocracy': willingness to defer decisions in the absence of an option, decreasing expectations to be listened to by decision makers, and a suspicion that the public is ill informed. Depending on one's views on technocracy as a regime of governance, this might become a rather problematic trend.

Mobilisation of scientists: supporting the impact agenda

The massive Research Excellence Framework (REF 2014) scored research units also on 'impact in society.' While news coverage of one's research does not count as 'impact,' it is clear that media attention is a pathway to impact, and likely to become part of impact management. Most universities are thus professionalising their communication function. The question remains whether the mobilisation of scientists has broadened or intensified among those already doing it as happened in France's CNRS (see Jensen, 2011).

Increasing media coverage of science and the crisis of science journalism

The Royal Society's Public Understanding of Science Report of 1985 had impact: it successfully mobilized the British mass media, print and broadcasting alike. Science news has increased massively to historically unprecedented levels of coverage (Bauer, 2012). However, but this trend reaches a turning point by 2007 (MACAS project).

While science communication is booming, science journalism is in crisis. The legacy media are endangered, and so are full-time science reporters. There is mounting pessimism among science journalists about their future (see Bauer et al., 2012).

An increasingly unrealistic image of science in the United Kingdom public

Eurobarometer 2005 and 2010 asked about the image of science: “science and technology can sort out any problem” (omnipotency), “new inventions will always be found to counteract any harmful consequences of scientific and technological developments” (self-correction), “one day we will have a complete picture of how nature and the universe works” (worldview), and “there should be no limits to what science is allowed to investigate” (no limits). Agreements on these four items are highly correlated to form an index of an unrealistic ‘myth’ of science (Bauer, 2015).

Holding to myths is positively correlated with science familiarity in Turkey, while in the United Kingdom the correlation is negative: the more familiar we are with science, the less we subscribe to these myths. However, Eurobarometer 2005, 2010 and BIS-BAS 2014 suggest that holding on to myth is increasing in the United Kingdom; at the same time as familiarity with science increases, so too does resigned trust.

Conclusion

This suggests that the science culture in Britain, rather than an immediate post-Brexit melt-down, shows some long-term trends and counter-trends that deserve closer attention. In the long run, familiarity with science has increased, trust in truth telling science increased, the utility of science is unshaken and moral reservations declined, but interest is science is laming among a well-informed public. This mundane normalcy of science in everyday life is juxtaposed by an increasing **acquiescence of technocracy,** willingness to defer decisions in the absence of option, decreasing expectations to be part of the decision making and a suspicion that the public is ill informed. This is a potentially worrying trend.

The field of science communication is very active, though peaked in 2007, and the increased mobilization of scientists into societal impact might contribute to an unrealistic image of science. Myth is a shaky and risky foundation for a future that is acquiescent with technocracy. Is Britain cultivating a ‘secular priesthood’ for the United Kingdom, and all the bad rhetoric of ‘enough of those experts’ actually means ‘enough of false experts’? Watch that space!

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