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OPINION

Social Sciences in the Public Understanding of Science

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ABSTRACT

This essay locates the academic discourse of public understanding of science and technology (PUST) in the context of utopian ideologies of Western Democracies, and in the nationalist discourses on economic development. The role and scope of PUST in the globalised, networked world, buffeted by neoliberal ideologies is discussed in the next section. The internal history of PUST is documented through the conceptual phases in the development of its discourses, along with the epistemological differences – such as deficit model, public engagement and science in society. In the last section of the essay, I briefly deconstruct the conceptual and methodological aspects of PUST. While most of the researchers of PUST use social science concepts and methods to communicate (natural) science to lay publics, there is a general absence of communicating social science concepts to the lay publics. I posit a few ideas for the reasons of this lack of reflexive praxis by the PUST researchers and a few suggestions for way forward to inclusive social science communication within PUST.

KEYWORDS: Public Scientific, Understory of Science, Discourse, Science Communication, Science Teaching

Prologue

Science popularisation - through academic publications, conferences / workshops, mass media or social media - can be conceived as having a 'Supply side' as well as 'Demand side' aspects. What is understood as 'Science Communication' can be construed as supply-side aspect of science popularisation and on demand-side it can be termed as 'Public Understanding of Science'. Science Communication is mainly concerned about the content and methods of delivering the science, while Public Understanding of Science can be conceived of reception and internalisation of the science – both the content and praxis of science. In the following pages, I will use the generic term 'Public Understanding of Science and Technology (PUST) to refer to both supply side as well as demand side facets of science popularisation – in the present context.

The main argument of this paper is that the social sciences have formed and reformed our self-understanding as social beings, and in important respects structured—and continue to structure—modern life. Therefore, PUST practitioners need to critically and contextually scrutinize social sciences in the same way as they did for the natural sciences.

Europe has a long history of science popularisation (David Knight, 2006) mainly undertaken by practising scientists. The academic discipline of public understanding of science and technology (PUST) has emerged in Europe and later in the USA in early 1980s due to concerns such as (1) the lack of intellectual public support for scientific ways of thinking and (2) legitimize continued funding for public scientific research work. Science (and its applied aspects, viz, technological artefacts) were considered as the main drivers for national economic development. Scientific literacy is equated with enlightened citizenship. In India, scientific temper – enunciated by Jawaharlal Nehru and others – was seen as antidote to superstitions and general well-being of citizens. Therefore, diffusion of science and technological understanding among lay 'public' became the mandate of governments – both of democratic and despotic versions – throughout the world. PUST gained traction as the legitimizing device for the governments funding of science – particularly the 'big science' which required large amount of monies for the infrastructure and scientific / technical manpower.

Science popularisation can also be seen as an ideological effort by the hegemonic structures in nation states (Gavroglu 2012). The extensive science popularization undertaken in the post-World War II era had another important objective – viz., the formulation and legitimization of utopias. In the fifties and sixties, it was the utopia of a world of cheap and limitless energy for all. The ideology of technocracy so closely associated with the post-World War II hegemonic ideology and the utopia of a world with endless supplies of cheap energy, needed to be continuously revamped, needed to be continuously legitimized through a host of specific success stories. both in science itself as well as its popularizations. In the later half of twentieth century, the utopias that were popularised related to molecular biology and its applications. The public perception of biological research is heavily anchored in reductionism. Such reductionism has been the net outcome of popularization attempts. Reductionism far from being a methodological or even a philosophical topic, has, over the years, become part of an ideology, which emphasizes that the problems one is facing have been in the genes all along. Gavroglu (2012) identifies that there are two kinds of ideologies involved in the process of popularization - one is the ideology expressed by the very act of popularization, by the enterprise to popularize itself; the second is the ideology embedded in the content of science that is being popularized, in the appropriate discourse used for the popularization of science. In the very act of popularisation, the ideology of achieving an egalitarian society as a utopia – in which the gap between scientist – lay public is sought to be bridged by science popularisation. Hegemonic constructions of Vedic science can be seen as another instance where the mythologies of the past are touted as the scientific achievement, in India.

Science and technology as they are produced and diffused in the recent past, are different from the twentieth century. First, science and technology are increasingly governed at multiple sites – largely by private corporate actors, by diverse actors and in disparate ways. Second, there are widespread cut backs in funding and infrastructure to public scientific and technological universities and centres. Thirdly, most of the knowledge that is produced is protected under various intellectual property regimes and or made inaccessible behind ‘pay-walls’ (journals and other academic literature). At the same time, most the governments are harping on scientific and technological innovations as the drivers to societal well-being, in economic and social welfare.

The widespread diffusion of Information and Communication Technologies facilitated global reach of science and technology erasing time and space barriers. Availability of internet and of mobile devices, including smart phones, have enabled generation of large amount of ‘big data’ – which are stored and analysed in real-time using array of server-farms (cloud computing). The internet is increasingly used for interactive, many-to-many communication in which user-generated content is exchanged and the distinction between senders and receivers is blurred—a development software producer Tim O'Reilly has famously called 'Web 2.0', and which scholars label 'social media.'. This new platform 'digital public sphere' has encouraged citizens to voice their opinions / views on aspects of science and technology which they feel impinge on them – mostly under the anonymity and instantaneous time frame – features which are not available in public participation or engagement exercises (Schafer 2012). Most people do not pay attention to science regularly, although they encounter and benefit from it in their everyday lives. They seek to make sense of it only when it is important to a decision they must make as individuals or in the context of institutions in which they have a role-as consumers, patients, parents, voters, or policy makers (Elam and Bertilsson, 2003).

Along with these developments, the neo-liberal economic policies adopted by most of countries, including India, have resulted in privatisation of scientific research and its results (intellectual property regimes). The messages and framing of these 'science communication' must be adapted to these transformations.

We live in an era where most policy debates relevant to science and emerging technologies are not simply scientific / technical issues. Rather, they are collectively decided at the intersection of politics, values, and experts' knowledge. Scientific disciplines have multiplied – rhizome-like – into many narrow specialisations, each with its own jargon and 'communities of practitioners' – with the result communication of the results of these researchers outside these specialisations need mediations – such as science communicators, media and internet, to make these scientific results accessible to a large section of people. These trends have redefined science communication as a discipline.

The western countries are besieged with issues relating to sophisticated public outreach and engagement to overcome perceptual gridlock on climate change, for encouraging public acceptance of the teaching of evolution in schools, for meaningfully involving the public in societal decisions about biotechnology and nanotechnology, or for effectively engaging with stakeholders and a wider public on almost all modern technologies. Human societies have acquired so much knowledge and expertise about mitigating the personal / social dangers they face but at the same time have not acted upon with the urgency needed. This disjunction, which features the persistence of divisive conflict in the face of compelling scientific evidence, is referred to as the “science communication paradox” (Kahan 2015)

On the other hand, the developing countries, particularly in India, are concerned to spread values and attitudes of scientific culture among broad sections of people – scientific temper among the lay people. The issues before developing countries is to inculcate rational attitudes and values among lay people who can then participate in public policy making and contribute to the progress of the society and nation. These concerns become even more important as India moves from traditional resource based economy to knowledge based economy (as is evidenced by the constitution of India’s National Knowledge Commission in 2005 (National Knowledge Commission, 2009). The so-called knowledge-economy requires, inter alia, people who are skilled and educated in science and technological subjects. These people must be able to conduct research and undertake development initiatives to improve and scale-up production of high technology goods and services.

Evolution of Public Understanding of Science and Technology

The academic discipline of public understanding of science has flourished since 1970s with the establishment of teaching courses, research and diffusion of the research through (1) academic journals such as Public Understanding of Science, Science Communication, Science Technology and Human Values etc, (2) annual conferences of its professional researchers (Public Communication of Science and Technology, PCST) and (3) professional training of Science Journalists etc. The basic terminology of the discipline - such as science (and its relation to technology) public and communication have been debated in these fora as also the theoretical /methodological bases of the disciplinary practices. Burns *et al.*, (2003) map the various schools of thought and offer a 'contemporary' definition of science communication:

‘as the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the vowel analogy);

- Awareness, including familiarity with new aspects of science
- Enjoyment or other affective responses, e.g. appreciating science as entertainment or art
- Interest, as evidenced by voluntary involvement with science or its communication
- Opinions, the forming, reforming, or confirming of science-related attitudes
- Understanding of science, its content, processes, and social factors’

Bauer (2009) identified 3 stages in the growth of science communication literature – (1) Science Literacy (1960 onwards), (2) Public Understanding of Science (1985 onwards) (3) Science and Society (1990s onwards). However, as Lock (2008) documents the history of PUS(T) in the UK, this evolution is not a linear one. The history of the public understanding of science has highlighted the complex nature of debate in the UK, where multiple positions on, and social constructions of, 'science', 'the public', 'society' and 'science communication', have existed, and continue to exist, simultaneously. Epistemological differences exist within and across all these schools of thought, Lewenstein (2003) identifies them as 4 ‘epistemological models’

The deficit model – assumes that the lay public are uninformed who need to be educated of science (influenced largely by the ‘diffusion of innovations’ model of Rogers (1983). The rhetoric in this model permeates with ideas that science, and scientists, could help make society and the public better, create a better citizenry, and a better functioning democracy, and improve the nation's industry. Equally it constructs in opposition, a public which is passive, often irrational, and in need of scientists' help. The main actors in this phase of the PUST were mainly scientists themselves, who needed both funds and legitimacy from the government and public. Social scientists, who were working in the academic disciplines, such as STS researchers also enter into the fray, in the late 1980s having obtained the funding from the government to define and manage PUST and they too began to colonise this space, mobilising their own knowledge and expertise, and in doing their own boundary work.

The contextual model, a critical theory based model - accedes that individuals are not empty containers to information, but rather process information according to social and psychological schemas (worldviews) that have been shaped by their previous experiences, cultural context, and personal circumstances. The entry and mobilization of social scientists into PUST has introduced new discourses and meanings into the research work in this area. Scientists continued to mobilise a 'science' which was separate from the public, but needed to combat public misunderstanding of pseudo-science, or relativist social scientific claims. Social scientists were rhetorically reconstructing these boundaries, and thus the relationship between science and public, in a very different manner. The general unease felt by the practitioner-scientists and social scientists working in the area of STS (and PUST) is manifested in eruption of a debate dubbed as ‘Science Wars’. These debates were triggered by an article published by Alan Sokal in 1996 in the social science journal ‘Social Text’ – which was later admitted by Sokal as a parody later in another journal ‘Lingua Franca’ in 1996. This parody provoked a huge debate between scientists, philosophers, social scientists etc in the next 5 years. The “war” is between scientists who believe that science and its methods are objective, and an increasing number of social scientists, historians, philosophers, and others gathered under the umbrella of Science Studies. The latter group have disputed that science is impartial and in some cases search of truth is abandoned (Ross, 1996), Segerstrale (2000), and Ashman and Baringer (2001)).

Brain Wynne (1992), and others, advanced a model of the public which conflicted with a deficit model characterisation of them as ignorant and passive, and argued that the public could mobilise their own expertise in social situations involving science, and though their framing of issues could be different (drawing on a wider criteria of ethical, social, political, and moral perspectives), this should enrich the relationship between the two, and allow for more fruitful, and equal, discussion of scientific matters. The crucial difference between the two models (diffusion and deliberation) was therefore not the perception of the use of a medium, but rather the direction of the flow of information, knowledge and values. Such research led to a 'contextual' approach to the public understanding of science, which suggested a dialogic model of cooperation and negotiation between scientists and laypeople in developing shared approaches to concerns and aspirations for the future. This was the groundwork for a subsequent re-orientation of the discourse and activity of public understanding of science away from knowledge and education, towards a focus on social relations.

One strand of this research is called the “cultural cognition thesis” (CCT). CCT posits that certain types of group affinities are integral to the mental processes ordinary people use to assess risk. As a result, members of the public overestimate dramatic or sensational risks like terrorism and discount more remote but more consequential ones — like climate change (Kahan, 2015)

The lay expertise model argues that scientists are often unreasonably certain about their level of knowledge, failing to recognize the contingencies and / or possibilities that lay people can also contribute to the knowledge and policy decision. Conceptualisations such as culture of science (Bauer et al, 2011), cultural distance of science (Raza and Singh, 2009), belong this genre of academic work.

‘public participation’ or ‘public engagement’ model has emerged, focusing on a series of activities intended to enhance public participation and hence their trust in science and technology. This phase is characterised by increased use of social scientific expertise and language, by science policy-makers, and then very quickly by many scientific organisations in the wake of the influential House of Lords Report in 2000. The widespread uptake of the language of ‘dialogue’, ‘engagement’, and ‘public values’, and a widespread acknowledgement that scientists’ understanding of the public was of importance, suggest that the social

> scientists (the qualitative researchers) defined the terms and discourse in this phase. Under the new banner of 'science and society' many scientific institutions attempted to redraw the boundaries of PUS to include much of this language, and a different, less separate conceptualisation of the public. Much of the meaning of these terms were used differently by social scientists and scientists - a phenomenon Lock (2008) identified as 'lost in translation' from the social scientific to the scientific or policy arenas.

A variant of this model is the so-called 'emergence perspective' which valorises the processual aspect of science communication. A key implication of the perspective is that the spaces as well as the 'publics' of science communication is marked by profound heterogeneity and contingency. Diverse range of elements and relations 'become together' in the event of public engagement, and which ones actually do become together is a matter of contingency. Evaluation of these emergence model efforts have identified that public understanding of science has to be a continuous and sustained engagement rather than isolated small scale 'events'. The uptake of the term 'upstream engagement' highlights again the different approaches to the public and its relationship with science. Upstream engagement was promoted by policymakers to manufacture early consent for the products of innovation. Others promoted upstream engagement as a means of redrawing the boundaries between science and the public, to shift the focus away from what they argued was a narrow scientific and risk-based framing of issues that needed public discussion, and to open-up innovation to a wider range of social perspectives, which would potentially influence technological innovation in other directions, though with collective social consent. Within the mobilisation of the term 'upstream engagement' the public is both problematised and assigned an almost equal status as experts in decision-making about science and society. We can also identify the term being used to rhetorically construct the relationship between science and society in different, and often opposing ways. Many scientific and government actors conceptualise upstream engagement as a means of manufacturing public consent, or legitimacy, for their expertise or scientific products. Many social scientists, on the other hand, continue to deploy their own conceptualisations in which such boundaries are dissolved and public values and knowledges become part of a more egalitarian process of discussing and influencing the impact of science on society.

Science in society phase of PUST has uncovered ‘public deficits’ of other domain – instead of scientific knowledge deficit, it is ‘attitudinal deficit’ and ‘trust deficit’ that were sought to be bridged by the PUST researchers – which are mostly in the social scientific domain rather than the (natural) scientific domain.

Public engagement efforts have drawn criticisms on mechanisms adopted in the various ‘experiments’ – such as Danish consensus conferences, Science Festivals etc. These efforts have been billed as ‘top-down’ public relations efforts, mainly to mobilize the publics towards ‘end-goals’ that the scientific administrators want to achieve (Beder, 1999)

Yet another type of engagement of publics in science is the so-called ‘citizen science’ experiments – towards inquiry and discovery of new scientific knowledge (Martin 2017). In these experiments, lay publics participate in the observation, experimentation, instrumentation, analysis of the scientific work – along with expert scientists in diverse fields such as diverse: ecology, astronomy, medicine, computer science, statistics, psychology, genetics, engineering etc. In relation to behaviour and attitude to science, knowledge alone is not enough to affect a sustainable change, however the experiential learning afforded to participants in Citizen Science and public monitoring activities provides more than simply knowledge and can have a prominent effect upon the subsequent behaviours and attitudes of lay participants.

Disambiguation of Public Understanding of Science

Under the aegis of the Royal Society, concerns of the yawning gaps between scientists and lay public emerged in a report which crystallised the term 'Public Understanding of Science' (Royal Society 1985). Popularly known as the Bodmer Report, this report perceived shortcomings in the social relations of science, which the authors of this report felt derived from the public's lack of factual knowledge about science. The Report concluded that everyone should have some understanding of science, preferably starting from their school education. It urged parliamentarians to seek advice on scientific issues, and suggested that industrialists needed a better understanding of science if the UK economy was to be competitive. The report asked for more science in the mass media and urged scientists to improve their communications skills and to consider public communication as a duty The term ‘Public Understanding of the Science’ originated with the publication of the so-called ‘Bodmer Report’ by the Royal Society in 1985. Since that time, the terms ‘public’ ‘understanding’ and finally ‘science’ have been deconstructed by many researchers working in this academic discipline.

Public

After two decades of research work by PUST scholars, it now admitted that ‘public’ in public understanding of science is not a homogenous ‘idiots’ that the deficit model made it out to be. Instead, there are many ‘publics’ in any society – each varying by their cultural beliefs, worldviews, demands and capacities (Kahan 2015). We now live in a society made up of people who are more of the ‘Consumer’ than the ‘Citizen’. The transformation from 'citizen' to 'consumer' implies that people in their individual capacities (qua consumer) would be more interested in the scientific and technological aspects of his / her food /travel /entertainment needs rather than the impacts of global change on the environment or community in which he / she lives in (qua citizen).

Understanding

The earlier studies in the PUST have deployed mostly the quantitative methods to map the ‘deficits’ in the public’s understanding of science – one of the most significant and widely quoted study of this genre is by the Durant et al (1989) in Nature – typical of the science literacy model. The qualitative research took a different approach to the very idea of the public understanding of science. Rather than identifying what the public do and do not know about science, researchers explored how the relationships between non-scientists and scientists, and their institutions were negotiated and managed (Lambert and Rose 1996; Wynne 199,1 Yearley, 2000). They asked whether the public understanding of science really needed improving, and who would benefit by it. These studies identified that an increase in scientific knowledge (content) lead to more positive and accepting attitudes to science and technology, and campaigns to communicate scientific information to the public were being informed by this premise.

'Understanding' in PUST has also been shown to be ambiguous concept as it is used by the scholars working in PUST (Huxster et al 2017). Based on the semantic analysis of articles published in the journal 'Public Understanding of Science' during the year 2014 –all 67 of the articles published in 2014. Huxster et al define 'understanding' as follows:

One understands a subject (issue, concept, theory, etc...) only if one grasps how a constellation of facts relevant to that subject are related to one another (causally, inferentially, explanatorily, &c.) in such a way as to be able to make new connections or draw new inferences with novel information. As a result, the object of understanding is always a body—and never a single piece—of information.

Employing a digital text analysis software – Voyant – they compared the use of terms, definitions, and implied meanings of the terms 'knowledge' 'literacy' and 'understanding'. Mathew Slater and his colleagues show that researchers working in the area of PUST have most often conflated the terms 'knowledge' and 'understanding' as synonymous. Using another dataset of articles from 'Public Understanding of Science', from 2010 to 2015, Slater and his colleagues have found that very few of the papers measured understanding empirically, even if they explicitly set out to do so.

Science

Scientific research got embedded in high tech instrumentation with the result the boundaries between pure and applied research erased – science became 'techno science'. As opposed to the 'sciences' (as conceived, especially, by scientists and philosophers of the 19th and 20th centuries), the 'techno-sciences' do not even attempt to distinguish between theoretical representation of the world and technical intervention into the world. It is nowadays a commonplace that representing and intervening are part of every attempt to arrive at knowledge of empirical matters (Hacking, 1983). With the result that science communication subsumes both science and technologies and the disciplinary field of science communication has also come to be known as Public Understanding of Science and Technology (Bucchi and Trench, 2008)

Public Understanding of Science both in research and practice focused mainly on the physical, chemical and biological sciences, sometimes alongside fields such as medicine, mathematics and engineering. A content analysis of articles published in ‘Public Understanding of Science’ from 1992 to 2011, Bauer and Howard (2013) revealed that the big topics of PUS are “science in general,” genetics and biotechnology, physics, the environment and climate change. Food, medicine and health had their presence as well. Less frequent are topics like psychology, mobile phones, computers and IT, geology or forensic science. Issues like nuclear power, genetics and biotechnology were covered extensively in the recent years – as most of these fields had ‘misunderstandings’ among the lay persons.

It is curious that Public Understanding of Science and Technology researchers (most of them with academic backgrounds in social sciences) have rarely conducted studies of public understanding of social sciences, or applied these critiques to communicating with non-specialists about their own findings. Research literature on public understanding of social science continues to be relatively sparse and scattered across many disciplinary areas (Cassidy, 2014). Angela Cassidy’s survey of such studies, however, focuses mostly on the ‘supply side’ – viz, social scientists communicating their expertise to the lay publics through mass media. There is virtually no study reported on the communication, reception, attitudes towards social scientific content and / or methods in this review paper. Most of mass media coverage by specialist science journalists and / or special programming tends to be of natural science disciplines, although social sciences such as psychology and economics do receive some specialist attention. Evans (1995) observed that science journalists refer to the natural scientists as ‘scientists’ while the social scientists were referred to as ‘authors’ – implicitly denying them of ‘scientific status’.

However, relatively little attention has been paid by public understanding of science researchers to how other academic fields such as the social sciences, arts and humanities are discussed in the broader public sphere (Schafer 2012). Even the cognate field of Science, Technology and Society (STS) has shown relatively little interest in studying the Social Sciences (for a sole exception see Camic et. al. 2014) An important justification for studying the so-called 'natural' sciences, and studying them in social context, has been that they affect the way we understand the world and the ways we lead our lives—just think about Copernicus' and Darwin's 'revolutions', medical progresses, or the social impact of information technology. The legitimizing role of Science is that these days, even religion tries to legitimises itself by invoking Scientific precepts / methods – like creationism / intelligent design. Centuries ago, in the beginning of modern science, it was religion which had that legitimising role – eg Newton who tried to get legitimacy to his physics by claiming that the success of his physics proved the existence of God !

Etymologically, science is derived from the Latin word 'Scientia' meaning knowledge –What we call science was first referred to as 'natural philosophy'. in the western context, Science comes into widespread use after 1300 AD and was primarily understood as knowledge acquired by study – it is only in the 18th Century that some notion of method was attached to science (including Philosophy). The Science Council of Britain defines science as follows:

Science is the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence

By this definition, both natural and social sciences qualify to be categorised under the rubric of Science.

Science is also an institution organised along the lines of a 'Church'- with clearly laid tenets on the boundary-work, norms and reward structures. Boundary work done by the scientists form a major role in what counts as science and what is not. boundary work identified by Gieryn (1983) - expulsion, protection and expansion - which scientists have spent centuries engaged in to construct their profession as a specific and/or distinct cultural domain. In the famous case on whether creationism and intelligent design can qualify as science, in the Kitzmiller v. Dover Area School District case in October 2004, the US Federal Judge, John E. Jones III, used the National Academy of Sciences (NAS) testimony to lay down the criteria which qualify the scientific work. According to NAS "Science is a particular way of knowing about the world. In science, explanations are restricted to those that can be inferred from the confirmable data – the results obtained through observations and experiments that can be substantiated by other scientists. Anything that can be observed or measured is amenable to scientific investigation. Explanations that cannot be based upon empirical evidence are not part of science." Following Gieryn (1983) we can say that scientist perform the boundary-marking function of 'protection' to demarcate scientists / science from the lay public. Science is constructed by scientists as separate from, but also essential for, a properly functioning society

In the early 19th century, French philosopher Auguste Comte proposed a scientific hierarchy ranging from the physical sciences at the bottom up through biology to the "queen" of sciences, sociology, at the top. A science of human social behaviour, Comte contended, could help humanity make moral and political decisions and construct more efficient, just governments. Public value is integral to the very nature of the social sciences since they emerged as separate disciplines out of moral philosophy in the eighteenth century precisely to better diagnose and improve the social condition. (Brewer, 2013)

In practice, however, this hierarchy is turned upside down within sciences – abstract sciences like mathematics and physics occupying the top rung, while the lower rungs are occupied by chemistry, biology, geology etc and in the lowest rung a few social sciences, like psychology and economics. Other social sciences are for all practical purposes are outside the reckoning of scientists – like the 'untouchables' of India'. This caste / class system within the academic subjects also reflect the privileges – like funding, social status to the scientists, and importance given to these subjects by policy makers, science communicators etc.

The Public Understanding of Science has strived to achieve multiple objectives, such as,

- make science accessible to all and increase science literacy;
- make apparent the relevance and importance of science to everyday life and society;
- increase the pool of people entering science-related careers, and
- through its dialogue and engagement exercises, to improve the democratic governance of Science and Technology

In these efforts, the discourses in PUS has typically diffuse the content and methods of science – particularly those emerging fields and technologies (bio-nano-info technologies and stem cell research, climate science etc). The questions for researchers of the public understanding of science becomes, where, and what sort, of scientific knowledge is sought and for what purposes?

The UK House of Lords committee published a report entitled Science and Society in 2000. Unlike in the Royal Society report of 15 years earlier, social scientists were key consultants to this report. With little emphasis on knowledge, the key issue was trust. It questioned the use of the term 'public understanding of science', which it considered irretrievably compromised by its association with the deficit model (House of Lords 2000), and argued instead for a more participatory, values-led approach to the exploration of science and society issues, and with clear links to policy-making. Ideas about negotiation and trust relations are the domain of social scientists rather than natural scientists, and they stressed the importance of interactions over de-contextualised cognitive content of science. The divide grew between scientists and public understanding of science researchers, with scientists tending to find themselves allied with the practitioners rather than the PUST researchers. These PUST social scientists tended to problematise the institutions that scientists took for granted, including society, the media, the public and science itself – many of whom also work in the area of Science Technology Society (STS) area.

Researchers working within PUST on controversial issues – such as climate change, nuclear technologies, stem cell technologies, etc have increasing used social science concepts and methodologies to engage lay people (Weber, 2010, Scheufele, 2013). In these engagements, social science concepts and methods (such as focus group research) are used as ‘vectors’ to achieve scientifically desired objectives – eg climate change adaptation behaviours.

Science uses the tools of empirical deduction and rational induction, based upon objectivity, with formally accepted standardized styles of texts and categories, applying such legitimizing tests as reliability and external/internal validity, with the goal of replicating phenomena and generating new knowledge through an analysis, for pure and applied scientific purposes, to explain natural phenomena.

As an extension of the natural sciences, social science research emphasizes empirical methods that seek to explain causality of social events. This method can be expressed in either a quantitative design, which approaches social phenomena through quantifiable variables and evidence, often relying on statistical analysis to create valid and reliable claims, or in a qualitative design, which emphasizes understanding of social phenomena through direct observation, communication with participants, or analysis of texts, and may stress contextual and subjective accuracy over generality

Social Sciences' Goals / Methods

1. Application of an empirical, rational, and objective methodology (use of validity and reliability tests) to present the "facts"
2. Function is to analyze, explain and possibly predict human behavior (as groups and/or individuals)
3. And to generate and produce new knowledge (factual information)

Concepts and Methods in Natural Sciences / Social Sciences

Scientific theory also creates and uses many new concepts which are not available in ordinary descriptions. In fact, invention of scientific concepts is a special characteristic of good science. Employing a reductionist methodology, science has achieved great insights into the natural world – from microscopic biological phenomenon to macroscopic astronomical objects. Scientists view science as a systematic process of observation and experiment that leads to deeper understanding about the structure and nature of the physical and natural world. Unlike most natural sciences, where the specialist training, knowledge and equipment of scientists grants them largely uncontested expertise, social scientists' expertise is often about matters of everyday experience and common-sense knowledge.

Anthony Giddens (1987) argues that there is a significant difference between the natural and social sciences. In the natural sciences, scientists try to understand and theorise about the way the natural world is structured. The understanding is one-way; that is, while we need to understand the actions of minerals or chemicals, chemicals and minerals don't seek to develop an understanding of us. He refers to this as the 'single hermeneutic'. (Hermeneutic means interpretation or understanding.) In contrast, the social sciences are engaged in the 'double hermeneutic'. The various social sciences study people and society, although the way they do so is different. Some social sciences such as sociology don't just study what people do, they also study how people understand their world, and how that understanding shapes their practice. Because people can think, make choices, and use new this new information to revise their understandings (and hence their practice), they can use the knowledge and insights of social science to change their practice.

In outlining his notion of the 'double hermeneutic', Giddens (1984: 20) explains that while philosophers and social scientists have often considered the way "in which lay concepts obstinately intrude into the technical discourse of social science," ... "(f)ew have considered the matter the other way around." – how social science concepts, in turn enter into the life-worlds of lay people. This insight is key to public understanding of social science.

Possible sign-posts for future public understanding of social sciences

Social science is both theoretically informed and empirically driven, committed to developing evidence-based observations, descriptions and explanations through theoretical and empirical investigations. This makes social science explanatory rather than just descriptive, combining theoretical insight with empirical rigour. The research agenda of the new public understanding of social science is distinguished by applying these scientific skills to the analysis of the fundamental problems of culture, the market and the state in the twenty-first century

Such shifts in new social sciences is possible through their application to issue based problems rather than discipline based problems. Brewer terms this approach as '(P)ost-disciplinary social science'. In this approach problems are no longer defined in terms of the received wisdom of individual disciplines, but by the technical features required to understand, analyse, explain and ameliorate them. When the post-disciplinary social science products are co-produced through public engagement of citizens / consumers, it achieves its saliency.

For the public understanding of social science perspective, such post-disciplinary research implicates different modes of communication and language. Collaborating across the social sciences and with other branches of science, and in liaison with co-producers of knowledge amongst publics with a stake in the research, requires a common language. This means lessening the use of in-group, professional vocabulary, and it involves a stylistic change, in which social scientists write to make themselves understood rather than for professional achievements.

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