Introduction: What Comes after Constructivism in Science and Technology Studies?

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Abstract

Constructivism has become the overarching scientific paradigm in the social study of science and technology (STS). The notion that scientific facts and technological artefacts result from processes of social construction is the major scientific innovation of the preceding decades in the sociology of science and technology. With constructivism being the established paradigm in this field of research: what comes next? What comes after constructivism in science and technology studies? The contributions of this special issue of *Science, Technology & Innovation Studies* suggest different answers to these questions which can roughly be subsumed under the three headings "Spelling out Constructivism", "Adding Disregarded Aspects", and "Going beyond Constructivism".

1 Introduction

Constructivism has become the overarching scientific paradigm in the social study of science and technology (STS). The notion that scientific facts and technological artefacts result from processes of social construction is the major scientific innovation of the preceding decades in the sociology of science and technology.

In the field of science studies this notion has had the characteristics of a revolutionary change. The emerging sociology of scientific knowledge was no longer content with merely analysing the institutional dimension of science as Robert K. Merton (1973) did. Its proponents no longer accepted the distinction according to which scientific truth is to be explained by the inner logic and rationality of science itself, whereas social influences are treated to be "extra-theoretical factors" accountable for scientific endeavours to go astray. In contrast to such a "sociology of error" (Bloor 1976: 8)[1] and in contrast to the Mertonian sociology of scientific institutions the then new sociology of scientific knowledge claimed that the content of science and not only its context should become the subject of sociological explanation.

No doubt, this approach in its different variants as "Strong Programme" (Bloor 1976), "Empirical Programme of Relativism (EPOR)" (Collins 1981; Collins 1983) or "Laboratory Studies" (Latour/Woolgar 1979; Knorr Cetina 1984) has turned out to be extraordi-

narily successful. A large number of empirical studies, were undertaken to show that and how scientific facts are constructed socially. These studies have demonstrated that many of the sociologists' conceptual and methodological tools for analysing and explaining social processes are also suitable for reconstructing and understanding the processes of generating scientific knowledge. It has been shown that scientific controversies are processes of social negotiation whose outcomes are a function of the interests, strategies and coalitions of the parties involved. Gaining common acceptance for scientific claims depends on the rhetoric skills, allies, and institutional resources (e.g. the already established scientific knowledge) the actors are able to mobilise. It has been demonstrated that many of the epistemic practices of scientists in their laboratories are similar to our normal everyday cultural practices of interpreting and understanding the world. Therefore, the same ethnographic methods which are used to study cultural practices turned out to be useful to study the epistemic practices of scientists and thus their cultural construction of scientific knowledge. Many studies have applied these basic methodological insights and have provided considerable evidence suggesting that social construction is a non-negligible aspect of scientific knowledge production.

With a delay of several years, social constructivism became adopted by technology studies, with Trevor J. Pinch and Wiebe E. Bijker (1984) being the pioneers of this development. The core assumption of the then new social constructivist sociology of technology is that technological artefacts are regarded as functional because they are successful – an assumption that contradicts the traditional view that technology is successful because of its functionality. From the social constructivist point of view, functionality is a relational feature, a feature a technological artefact gains by being seen as an appropriate solu-

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[1] Bloor (1976: 8) blames Mannheim to have based his sociology of knowledge on the aforementioned distinction. It is true that Mannheim calls social factors "extra-theoretical factors" (cf. Mannheim 1985 <1929>: 230). But it is a somewhat biased interpretation to conclude from this that the Mannheimian "sociology of knowledge is confined to the sociology of error" (Bloor 1976: 8). More rightfully, Bloor might have pointed, for example, at Joseph Ben-David (cf. Ben-David 1971: 11-13).

tion to a relevant problem. Thus, becoming an appropriate solution to a relevant problem – becoming successful – defines the functionality and usefulness of technological artefacts. In other words: technological artefacts are constructed socially.

Social constructivism in the field of technology has never been perceived as being as revolutionary as in the field of science. It is true that social constructivism is opposed to common assumptions about technological functionality. And it is opposed to assumptions about technological imperatives governing paths of technological development. However, few people who share these assumptions – laymen, engineers or students of technological change – would disagree with the proposition that a technological artefact's success is dependent on its users' acceptance. Thus, social constructivism is less controversial in the realm of technology than in the realm of science. Technological artefacts are constructed as means to achieve human ends. Only those who challenge this basic assumption and believe that technological development has become an end in itself have reason to reject social constructivism in technology studies.

Nevertheless, applying social constructivism to technology brought about a major change. It triggered the development of the sociology of technology (and the social studies of technology respectively) as a distinct field of scientific research. Different strands of research on technology in historical, philosophical or political science, in sociology of industry or in innovation studies now became recognised and re-evaluated as contributing to the social constructivist approach. Once explicitly articulated, the scientific paradigm of social construction of technology turned out to be a powerful focussing device which bundled and combined the hitherto fragmented research on social processes of technology development.

Twenty years after the initial formulation of the "Social construction of technology (SCOT)" as a research programme by Pinch and Bijker, we can look back to a considerable amount of empirical research. Many different technologies have been studied from the point of view of social constructivism. Maybe, some of the research has put too much weight on demonstrating the obvious, namely that technology is socially constructed (cf. Woolgar 1991: 36; Sismondo 1993: 543). But at the same time we have learned a lot about what is much more interesting: *how* technology is constructed socially (cf. Joerges 1995) It turned out that the interrelatedness between a technology's context of development and its context of use is of greatest significance for answering this question. Looking back it is thus safe to say that social constructivism is a successful research programme in technology studies, too.

The "science wars" debate (cf. Bammé 2004) has shown that social constructivism of science has not jet lost its provocative power. But it is provocative only for those who are doing science and not for those who are observing doing science.[2] For doing science, realism (naïve realism, critical rationalism, methodological positivism or other variants) is the standard operational epistemology. For researchers who do science the assumption that they deal with their research subject and not "merely" with social constructions is to a certain degree as inevitable as it is functional. Thus, it comes as no surprise that social constructivism, while being normal science for the scientific observers of science, still gives offence to the scientists observed.

Although less pronounced, a similar distinction between practitioners and observers can be found in the field of

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[2] If one leaves aside the more specialised critique of postmodernist story-telling about science (e.g. the "Sokal hoax").

technology. As the scientist's, primary concern with her research object makes her lose sight of the social contingencies of the knowledge production process, the engineer's primary concerned with problems of technological feasibility makes him neglect the technology's context of use. The "acid test of the market", however, continually reminds him that it is ultimately the users whose interpretations and patterns of use turn his work into a successful (or failing) technological innovation.

Michael Guggenheimer and Helga Nowotny contended that the present state of science and technology studies is characterised by a "joy of repetition" (2003: 231). Even today, much research in science and technology studies is designed to demonstrate that this scientific truth or that technology is constructed socially. In the face of a scientific climate that favours the realism of the natural sciences rather than the constructivism of the social sciences, and in the face of an engineering culture with limited attention to the social features of technological design, the tendency to point out again and again what is already sufficiently proven is understandable. However, as Guggenheimer and Nowotny suggest, this repetition might also indicate a certain stagnancy of science and technology studies.

Fighting past battles – as it happened with the "science wars" debate – is not a promising future for science and technology studies. So what *is* the future of STS? With social constructivism being the established scientific paradigm of the social studies of science and technology, what comes next? What comes after constructivism in science and technology studies?

We suggest that are three different answers to this question: (1) spelling out constructivism, (2) adding disregarded aspects to constructivism, or (3) going beyond constructivism. According to Thomas Kuhn (1962), the

establishment of a new scientific paradigm is followed by a phase of "normal science". Normal science means to implement in research practice what the paradigm at first merely promises, to concretise what is initially a general idea, and to deal with the paradigm's implications, many of which are unrecognised in the beginning. 'Normal science' thus means to spell out the new approach.

A second characteristic of a new paradigmatic approach – besides being little more than a rough idea initially – is its tendency to be excluding and unfair against antecedent or rivalling approaches. Since proponents are interested to highlight the originality and superiority of the new approach they tend to downplay all the achievements that different approaches have already contributed or may contribute in the future. A good example of this rhetoric strategy is Bloor's somewhat pejorative characterisation of Mannheim's approach as a "sociology of error". Once the new scientific paradigm is established, these over-accentuated demarcations become less important. This opens up the opportunity to look for aspects in which the new approach and its predecessors or rivals complement each other rather than holding competing views. For instance, after studying the very content of science has become an established approach, there is little reason why studying the institutional context of science should be seen as a competing rather than as a complementary area of research in the social studies of science (cf. Schimank 1995). Seeing constructivism as firmly established, the second answer to "What is the future of constructivism in STS?" is that now it is time to add disregarded aspects of this kind.

However, it may turn out that research governed by a paradigmatic scientific approach comes to face problems that can neither be solved by spelling out the approach nor by adding disregarded aspects. Such anomalies, if they

are important enough and if a new paradigm is put forward with a plausible promise to solve these problems, may, according to Kuhn, lead to a new revolutionary situation and to the displacement of the established approach by a new one. In the case of constructivism, we see two problems that may have such a paradigm-changing quality: the reflexivity problem ("if scientific propositions are social constructions, then this holds for this proposition, too") and the problem of material agency. And there is at least one prominent scientific approach – actor-network theory – which claims to be a new scientific paradigm, to go beyond (and not behind) constructivism and to be able to solve both problems. The third answer, thus, is that the days of constructivism in STS are numbered and that postconstructivist or "posthumanist" (cf. Pickering 2005) approaches such as actor-network theory will take over.

It should be added that the distinctions between these three paths of constructivism's future are less sharp than the application of the Kuhnian terminology makes it sound. For instance, actor-network theory and other post-constructivist approaches are deeply rooted within constructivism so that one could argue that they are forms of spelling out implications of constructivism rather than new paradigmatic approaches. Nevertheless, it does not seem to be completely misleading to subsume the answers given by the authors of this special issue of the *Science, Technology & Innovation Studies* under the three headings "Spelling out Constructivism", "Adding Disregarded Aspects", and "Going beyond Constructivism".[3]

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[3] Preliminary versions of this special issue's papers were presented at the Annual Conference 2004 of the German Association for Science and Technology Studies (Gesellschaft für Wissenschafts- und Technikforschung e.V.) in Berlin, Nov 26-27.

2 Spelling out Constructivism

In her article "The Topicality of the Difference Thesis: Revisiting Constructivism and the Laboratory", *Martina Merz* begins with the observation that constructivist STS never has been a monolithic endeavour, but from the very beginning existed in two variants. Although these two variants share basic conceptual assumptions and research issues, they differ strongly when it comes to the question of extending the foci and loci of STS research, especially when moving beyond the walls of the laboratory. According to the first variant of constructivist STS (termed the analogy approach), there are no epistemic particularities of knowledge production in the laboratory. Although an important cornerstone of STS, this variant is limited to examining and showing the locally constructed and negotiated character of facts and artefacts – issues that cannot be considered as challenges today. The second variant (termed the difference approach) states that there is something specific about the scientific laboratory: The power to reconfigure subject-object-relations, and this power is stronger than within any other social organisation, and can explain the success of the laboratory in modernity.

Focussing on the continuing topicality of the difference approach can, according to Martina Merz, lead to a whole research programme that can be summarised as "transcending" versus "extending the laboratory", both of which have not been spelled out within the constructivist approach. "Transcending" the laboratory asks how results that were locally produced in the lab can be successfully exported or transferred to other settings. Concrete questions on this line of research could be e.g. to investigate the conditions of the transferability of scientific results, thereby explaining its power in more depth, or to explore more systematically the epistemic practices that account for the disembedding and the

re-embedding of objects and results. "Extending" the laboratory raises the question whether laboratory-like features of knowledge production can be identified in other societal realms, like e.g. in the practices of object reconfiguration in interdisciplinary research areas like computer simulation and environmental sciences. While still being in the line of constructivist STS, all of the questions raised in the article of Martina Merz can give way to a more concrete exploration of the issues related to the notion of the knowledge society.

With their article "Three Forms of Interpretative Flexibility", *Uli Meyer* and *Ingo Schulz-Schaeffer* subject one of the core concepts of constructivism – interpretative flexibility – to a systematic analysis that leads to a significant extension of the concept. The authors demonstrate that there are three rather than one form of interpretative flexibility, and that each of them is based on a specific regress of arguments in science. They adopt the work on the interpretative flexibility of scientific statements and the *regress of truth* (H. Collins). Meyer and Schulz-Schaeffer then analyse the approach to technological controversies of the "Social Construction of Technology (SCOT)" programme (Pinch and Bijker). They observe that this approach is far less convincing because it copied the concepts from science studies and overlooked that technological controversies deal with a different kind of interpretive flexibility, which is based on a *regress of usefulness*. In a third step, the authors use an empirical investigation of the controversy about neural networks to introduce a third and new type of interpretative flexibility that can be distinguished from the two others. This controversy addresses neither truth nor usefulness. The interpretative flexibility of statements about the potential of scientific or technological approaches is based on a regress of relevance: Which approach will best advance the scientific or technological development?

Having introduced three distinct forms of interpretive flexibility, the authors demonstrate the usefulness of their distinction by discussing switches of controversies. They identify a switch from the truth discourse to a relevance discourse in the controversy about gravitational waves, a switch from the usefulness discourse to a truth discourse in the controversy about bicycles, and a supplementation of the relevance discourse by a usefulness discourse in the controversy about neural networks. By demonstrating that all three forms of interpretative flexibility can and indeed do occur in scientific and technological controversies, they provide a powerful tool for the analysis of scientific controversies.

3 Adding Disregarded Aspects

In his article "Deliberative Constructivism" *Wolfgang Krohn* deals with the question: "How can we, as scientific observers of scientific enterprises, distinguish between good and bad constructions of knowledge?" (p. 42) Obviously, in knowledge societies this is a question of considerable relevance. But it seems to be a question that is impossible to answer from a constructivist point of view. If scientific knowledge is the result of a process of social construction, so are the criteria for the assessment of its quality. These criteria are thus shaped by interests, prejudices, status, values, and world views and cannot be used by a scientific observer to distinguish between good and bad constructions. At the same time, however, constructivism invites the observer to take a normative stance: "precisely because our methods and concepts in the production of knowledge and the justification of truth claims are culture bound, their relatedness can not only be observed but also controlled and adjusted – at least to some degree." (p. 43) This is, then, the dilemma of constructivism in the sociology of science: on the one hand, it shows that scientific knowl-

edge is manmade, meaning that the criteria of good science can be established deliberatively; on the other hand, however, it deconstructs truth as the scientific criterion for good (or bad) knowledge.

Wolfgang Krohn proposes a constructivist solution to this dilemma which he calls "deliberative constructivism". His main argument is a dialectical one: "Any attempt to determine the limiting conditions of a culture provides already cognitive options for transgressing the limits. ... From the impossibility of a 'perfect' translation it does not follow that it is impossible to distinguish between better or worse translations. Instead, the better the limiting conditions of both languages are known, the fairer can the search for an improved translation be guided including options for slightly changing certain language features. A similar argument holds for the justification of truth claims." (p. 54) If one observes specific dependencies of scientific knowledge on certain social or cultural conditions one can use this knowledge as a guide for reducing these dependencies. This is the basic idea of deliberative constructivism. From this point of view, "reconstruction of the relativity of knowledge is a potential contribution to expand its irrelativity" (p. 56).

4   Going beyond Constructivism

Actor-network theory (ANT) and constructivism in STS are roughly of the same age, thus there is good reason to evaluate actor-network theory with as much scrutiny as the former. This is even more so since both ANT and constructivism departed from largely the same sharp critique of the understanding of science and technology as it was established in the social sciences until the late 1970s. Though both approaches share their point of departure most of us would hesitate to call ANT a constructivism proper. In pur-

suing the common goal of "opening up the black box", ANT created its own very special approach and vocabulary, often also addressed as "symmetric anthropology".

Instead of systematically evaluating the theoretical perspective established by Michel Callon, Bruno Latour, John Law, and others, *Thomas Berker* in his contribution "The Politics of 'Actor-Network Theory'. What Can 'Actor-Network Theory' Do to Make Buildings More Energy Efficient?" undertakes it to confront ANT with a proof of its usefulness by re-analysing its virtues in an empirical project in technology development, while at the same time following the line of critical comments and discussions developing the ANT approach further on. In doing so he employs two different images of ANT, or shall we say: perspectives, that is, "ANT in the making" and "ANT as a tool, which can be applied to understand the world". His core argument is that in order to get the best out of ANT for analytical purposes it is mandatory not to "privilege either the applications of 'ANT' or 'ANT in the making'". He, thus, pleas for refraining from re-establishing a false dualism of on the one hand the tool character of a black boxed ANT in an application perspective and on the other hand the open-ended process of theoretical advancement of ANT. Obviously this is in itself an ANT-based argument deeply rooted in the anti-dualistic concerns of the ANT's founding fathers.

Peter Wehling in his article "The Situated Materiality of Scientific Practices: Postconstructivism – a New Theoretical Perspective in Science Studies" focuses on a line of debate which is occasionally labelled as post-contructivist studies. He combines it with one of the most relevant perspectives in the current debate of a sociology of scientific knowledge: the debate about forms and consequences of scientific non-knowledge. His thesis is that the fruitfulness of postconstructivism and its attention for the situated

material and discursive practices could be demonstrated with respect to the debate of non-knowledge: "no less than knowledge, non-knowledge is embedded and inscribed in practices conceived as material reconfigurations of the world." (p. 94)

To demonstrate this, Peter Wehling firstly sketches the history of the postconstructivist debate. In the course of this argumentation he outlines the insight of SSK that beyond of "bringing back in" material factors a self-reflective notion as to basic assumptions of SSK emerged. With respect to this result he argues secondly that the self-reflective turn could be demonstrated with regard to three key concepts: knowledge, practice and performativity. To establish another concept of knowledge he refers to the works of Joseph Rouse and his idea of a "deflationary" and "non-reifying" concept of knowledge. Following Rouse, he regards practices not primarily as "doings of social actors". Moreover, "an adequate conception of (scientific) practices has to encompass the material 'configuration of the world' (Rouse) which makes the activities of individual or collective agents become significant, coherent and intelligible." (p. 89) Additionally, he maps the idea of the performativity of scientific practices – against a "traditional" representationalist approach of science. Thirdly, Wehling shows the embeddedness of scientific non-knowledge with respect to general concepts (such as the concept of "epistemic cultures" of Karin Knorr Cetina, which could be extended to a concept of "scientific cultures of non-knowledge") and the debate on genetically modified organisms. He notices that the perspective offered could be fruitful "for initiating more self-reflective research practices, especially when such contrasting scientific cultures of non-knowledge [as in the field of genetically modified organisms, the molecular biologist and ecologist; the editors] are confronted with each other in public arenas" (p. 95).

5 Outlook

The contributions of this special issue on the question "What comes after constructivism in science and technology studies?" suggest that the constructivist approach is still a vivid source of inspiration in this field of research. Even the postconstructivist considerations are far from leaving the constructivist foundations behind. There is still a lot of work to do in order to spell out implications of the constructivist approach. At the same time, constructivism in STS now seems to be mature enough to ease initial cognitive restrictions, to broaden its scope, and to take considerations into account which complement the own point of view. In all these directions of considering the future of constructivism in science and technology studies much more is to be said than this special issue can cover. However, we hope it will serve as an impulse to re-examine the constructivist foundations on which much of our work is based.

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