RESEARCH FIELDS

15.0 SCIENCE AND TECHNOLOGY STUDIES (STS)

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ABSTRACT

From a database search and literature review, we've found that Science and Technology Studies (STS) is a field with philosophical and activist origins, and which involves the study of physical and technical sciences from a social science perspective. We've determined that the REELER project fits within the interdisciplinary field of Science and Technology Studies, as it is draws on STS-inspired philosophical and activist approaches to explore the concepts and materialities involved in the construction and implementation of robots. Lastly, we argue that REELER contributes to STS with empirical studies of the entanglements of materials, concepts and politics in the field of robotics.

15.1 Opening

STS can refer to "science and technology studies" or "science, technology, and society". The REELER project evolve and contribute to this filed in several ways. The REELER proposal has evolved in a constant dialog with theoretical contributions tied to this field notably the work in postphenomenology, actor-network theory and new feminist materialism.

STS emerged from the 1960s onward in different places around the world and under different names. Generally, it is an interdisciplinary field that has evolved over many years beginning with Thomas Kuhn's seminal study of *The Structure of Scientific Revolutions* from 1962. Massachusetts Institute of Technology (MIT) describe STS as a collaboration using "methods from the humanities and social sciences to understanding science, technology, and medicine around the world."[1] STS provides perspective on "human factors" in the sciences and that interdisciplinary collaboration brings understanding of "human challenges" at MIT.[2]

According to Adele Clark, many of the university based programs entitled "science, technology, and society" seem to stem from feminist academic social movements with an activist approach, while those identifying as "science and technology studies" emphasized a more theoretical approach.[3]

Most of these programs are connected with the umbrella organisations for STS research that also arrange meeting points and conferences for the researchers. The biggest is the American based 4S (Society of Social Studies of Science[4]) as well as the two European societies related to the study of science and technology: the European Inter-University Association on Society, Science and Technology (ESST)[5] with an activist

1 STS at MIT -- http://sts-program.mit.edu/

2 STS at MIT, About Us -- http://sts-program.mit.edu/about-us/

3 Clarke, Adele E. 2016. "Situating STS and Thinking Ahead." *Engaging Science, Technology, and Society,* 2: 157-179. DOI: http://dx.doi.org/10.17351/ests2016.64

4 http://4sonline.org/

5 ESST, About -- http://esst.eu/

approach, and the European Association for the Study of Science and Technology (EASST) with a more theoretical approach.[6] Furthermore these organisations interact with 'sister-organisations' like SCOT (Social construction of technology) and History of Science and SSK (The sociology of scientific knowledge).

REELER's place in STS lies more in the theoretical, research-oriented approach. REELER meets the context of STS in that it explores the innate interconnectedness of technology and the social sciences. This transdisciplinary focus is described by the Centre for STS at Aarhus University: "The complex intermingling of technological artefacts and human beings must be analysed empirically in concrete situations."[7] In STS there is a long tradition in doing ethnographic research in order to study how scientists and technical researchers create knowledge and things (so-called 'lab-studies) and in other types of ethnographic research follow the consequences of scientific research in the effects it has on the world. In the REELER project we combine these two types of study and contrast the 'lab-studies' with studies on effects on users.

To better understand how STS is constructed as a discipline, we have collected descriptions from some university and STS institute websites. In order to understand how REELER's research focus aligns with and may contribute to STS, we have performed a literature search. The results of both of these efforts are reported in the following sections.

15.2 Methodology

Our methodology for this literature search and review has been an iterative and active process. Our initial search began with SCOPUS, a multi-disciplinary database collection of abstracts for peer-reviewed texts. We also searched two disciplinary databases: ERIC, an education database, and AnthroSource, an anthropology database.

We began the search with a systematic review approach, inspired by the EPPI approach. Our aim was to identify search criteria and filters that returned consistently relevant results. Our initial search included the term *STS* and the alternate term *science and technology,* in combination with terms relevant to the REELER project: robot(ics), collaborative learning, ethics, gender, work/labour (with a particular search on Hannah Arendt's work), posthuman, AI and/or machine learning, case studies, Triple Helix, etc.

It was difficult to find a search string that returned results relevant to REELER. This was due in part to the ambiguity of both *STS* or *science and technology.* Ultimately, the combination of the terms *STS* and *science and technology* with *robot, robots,* and *robotics* returned the most relevant results – but even the ambiguity and redundancy of *STS* skewed the results. STS is an abbreviation in healthcare and robotics that refers to a specific human and humanoid robot ability, the sit-to-stand (STS) motion. Furthermore, STS is a field of study; as such, it may be redundant to mention STS in scholarly texts published within that field.

In the second cycle of our literature search, we looked more closely at the searches for variations of *STS* and *robot* in the SCOPUS, ERIC, and AnthroSource databases. The texts returned were largely irrelevant and were not authored by any of the most well-known STS scholars who've written about robots. After a review of the abstracts for the selected extended searches [highlighted in Table 3 in the Appendices], we concluded that our approach to the literature search would need to be adapted to the interdisciplinary field of STS. While a

6 EASST, About -- https://easst.net/about-easst/

7 Centre for STS at AU -- http://sts.imv.au.dk/en

multi-disciplinary search for *STS* is too broad and ambiguous, narrowing by discipline could exclude many STS scholars.

STS scholars come various disciplines and might publish within their disciplinary journals, in interdisciplinary STS journals, or in extradisciplinary journals related to their subject of study. Thus, though they may meet on a yearly basis in conferences arranged by the umbrella organisations 4S and EASST, they may publish in journals that are not connected to the STS community at all. Jennifer Robertson, for example, has published her anthropological articles about robots in: *Critical Asian Studies,* a cultural studies journal; *The American Interest,* a political magazine; and *Body and Society,* an interdisciplinary subject-oriented journal. Robertson, however, is educated and practiced in anthropology – yet, none of her articles on robots are available in the AnthroSource database. A search of SCOPUS for texts authored by Lucy Suchman returned 30 accurate results. Although Lucy Suchman is an anthropologist, and the present president of 4S, the majority of these texts were published in computer science and engineering journals. These searches illustrate the difficulty of narrowing by discipline when searching for work within an interdisciplinary field, such as STS.

In the third cycle of the literature search, we shifted the search to STS journals and publications. We searched the journal *Science and Technology Studies* of the European STS association EASST, but did not return any hits for *robot* or its variations. A search of the longstanding 4S based STS journal *Science, Technology, & Human Values* (the journal of the Society for Social Studies of Science) returned 61 results, a handful of which were relevant and just a few of which were authored by well-known STS scholars. These searches informed our literature review to some extent, but most of the research underlying the discussion of STS has been built upon foundational knowledge and the sources traced out from these.

In the final iteration of our research process, we turned away from the EPPI approach and worked in a method similar to "snowball sampling"[8], in which a relevant source is identified and other relevant leads are traced out through this source and the next. We began with known STS scholars and their works, then examined works referenced by these authors or works referencing these authors. From this method, we found rich and relevant texts from authors known and unknown to us. The process was a back-and-forth process of examining texts and following references. It is primarily from these texts that the discussion section has been written.

This research process has highlighted for us the importance of disciplinary expertise in conducting a search and analyzing the results. Systematic reviews, like the EPPI approach, are useful for gaining insights and identifying trends. With some searches, both the queries and the results can be highly informative for a literature review. Certainly, for our search on case study methodology, the texts returned demonstrated the diverse approaches to case study research across and within disciplines. In our search on robots used in education, trends in term usage suggested different practices related to the term combinations <*education* and *robots*> and <*education* and *robotics*>. At other times – for searches like this search on STS – a reliance on search results alone can be ineffective and even misleading.

8 "Snowball sampling is a useful way to pursue the goals of purposive sampling in many situations where there are no lists or other obvious sources for locating members of the population of interest." (Morgan 2008, 816)

It was essential in our research process to be active in our search, adjusting the methodology according to the results. In unraveling the history of robots in STS, we have produced a certain learning through the search process, not only the search results. This process of learning and knowing is described well by Tim Ingold: "Inhabitants, then, know as they go, as they journey through the world along paths of travel. Far from being ancillary to the point-to-point collection of data to be passed up for subsequent processing into knowledge, movement is itself the inhabitant's way of knowing," (2011, 154). This last cycle in the search and review was more organic than systematic.

15.3 Overview of STS

Although the roots of STS go back much further, STS really took off in the 1970s. It began as a critique of the sciences, which had evolved from a history of philosophical pursuit of truths about the natural world (Sismondo 2010). STS pushed back against science as objective, natural facts and sought to recognize science and technology as active social processes: "The field investigates how scientific knowledge and technological artifacts are constructed. Knowledge and artifacts are human products, and marked by the circumstances of their production," (Sismondo 2010, 11). Social construction has been at the center of STS analyses from the start, but there have been several turns and offshoots in STS in the last half-century.

The academic field of Science and Technology Studies emerged from a historical interest in how knowledge paradigm evolve and die out in the natural sciences (Kuhn 1962) and sociological studies of how the values of scientists influence the sciences (Merton 1942). In the larger field of STS some 'schools' dealt with philosophical and psychological questions of knowledge creation in the sciences. The most influential field developed under the name of SSK (The sociology of scientific knowledge) in the 1960s and 1970s which is sometimes known as the Edinburgh School (because leading members like Harry Barnes and David Bloor were based in Edinburgh), but the SSK is also connected with University of Bath School, where the sociologist Harry Collins contributed to SSK. In this branch of STS natural scientific knowledge production was questioned in what came to be known as 'the strong programme' (Bloor 1976). In this programme, the focus was on the relativism of scientific truth and a scrutiny of the psychological, social and cultural conditions that informed scientific knowledge claims, how they succeeded or failed and how this kind of critique should also include the sociological observer of natural scientific knowledge production. Furthermore, there was a demand for symmetry in so far successful and unsuccessful natural scientific knowledge claims should be explained through the same principles. One of Collins students, Trevor Pinch, went on to create the field of SCOT (Social construction of technology) together with the Dutch sociologist Wiebe Bijker, in order to the strong programme was extended to technology. Another branch evolving in the 1980s were the so-called 'lab-studies', where researchers like Bruno Latour, Steve Woolgar and Karin Knorr Cetina followed natural scientists in their everyday work practices (Cetina 1981, Latour 1983, Latour and Woolgar 1986). The lab-studies were in many ways building on the strong programme but also deviated from it especially in Latour's actor-network theory. One way of explaining the difference is different approaches to defining the most important questions. For the strong programme the focus had been on how the social and cultural influence the production of scientific knowledge whereas for Latour and his followers it became the influence of science and technology on society. Furthermore, the symmetry proposed by Bloor as a social symmetry was enhance to become a symmetry between humans and non-humans in Latour's actor-network theory. Though Bloor warned of this development (Bloor 1999) it became Latour's symmetry approach that came to define STS-studies for more than a decade with its basic understading of the role played by technology in modernity

(Latour 1993). A special branch of STS evolved around a feminist perspective with the biologist philosopher Donna Haraway as a lighthouse questioning the bodiless accountability and objectivity of traditional natural science (e.g. Haraway 1992). Today this feminist brand has been informed by a number of contributions from feminists who, like Haraway, share a background in the natural sciences with the physicist Karen Barad (Barad 2007) at the front. There are also a number of neo-phenomenological approaches that also priviledge bodies in technology (e.g. the postphenomenology of Don Ihde 2002) and Tim Ingold's studies of dwelling and materiality (Ingold 2011). Today there are SSH-influenced scholars working in science and technology studies programs throughout the world building on these foundations from the 1960s onwards.

There are at least two concurrent but different approaches to the study of science and its processes. Until the millennial turn, STS referred to *Science, Technology, and Society* whereas S&TS referred to *Science and Technology Studies*. *Science, Technology, and Society* had an activist approach toward social issues related to science in society, whereas *Science and Technology Studies* had a sometimes empirical based but more philosophical approach to understanding science and scientific knowledge through human practices. The once distinct approaches have since converged and are now known collectively as Science and Technology Studies with the abbreviation STS. The resulting field is nevertheless diverse, with scholars from various perspectives, including feminist, phenomenological, and material – among others. Sergio Sismondo describes STS as it stands today:

"The field is a result of the intersection of work by sociologists, historians, philosophers, anthropologists, and others studying the processes and outcomes of science, including medical science, and technology. Because it is interdisciplinary, the field is extraordinarily diverse and innovative in its approaches. Because it examines science and technology, its findings and debates have repercussions for almost every understanding of the modern world."

(Sismondo 2010, vii)

In the 1990s the field of STS was hit by a number of blows in the so-called 'science wars' where physicists, chemists and biologists hit back at the social scientists and their critique of their natural science knowledge production. They critisised the 'social construction of scientific facts' theories and even ridiculed the way social scientists veiled their arguments in obscurant theories heavily inspired by what they claimed were misunderstood refereneces to natural science theories (e.g. Sokal and Bricmont 1998).

Today the pendulum swings away from the social construction approach towards an acknowledgement of e.g. the climate change as a fact of nature that cannot be explained away by social constructions. The focus is on bodies and materials more than the former occupation with the construction of abstract knowledge.

15.4 Conclusion: How REELER is positioned within the STS field

REELER fits naturally in the field of STS, with the project's focus on roboticists, robots, user experiences and affected stakeholders. The REELER project aligns with classic STS studies of scientists in their labs (Latour and Woolgar 1983, Cetina 1981). The multi-sited case study method, informed by anthropology, takes REELER out of the lab, however. REELER positions a robot as the centre of a case and explores the robot both as a material artefact and as an entangled technology-in-use. This approach fits with the shift in STS to materiality. Instead of contributing to the existing distance between roboticists and affected stakeholders, REELER seek new ways of aligning the collaborative learning between the disparate cultures and interests involved.

Furthermore, REELER contributes to the field of STS with a new perspective on how robots and robotics transform societies at large by challenging conceptions of the human and of work. Thus, REELER draws on the STS-inspired philosophical and activist engagements with the concepts and materialities involved in the construction and implementation of robots; and REELER contributes to STS with empirical studies of the entanglements of materials, concepts and politics.

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