KULTUR- UND TECHNIKSOZIOLOGISCHE STUDIEN

no 07/2010

Working Papers
kultur- und techniksoziologische Studien

bis 2011: http://www.uni-due.de/soziologie/compagna_wpkts
seit 2012: http://www.uni-due.de/wpkts
no 07/2010

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ISSN 1866-3877
(Working Papers kultur- und techniksoziologische Studien)

Vorwort

In der Reihe "Working Papers kultur- und techniksoziologische Studien" (WPktS) soll die diesbezügliche Forschung, die am Lehrstuhl von Prof. Karen Shire (Ph.D.) erfolgt, dokumentiert werden und NachwuchswissenschaftlerInnen, die eine sehr gute Seminar- oder Abschlussarbeit in einem vornehmlich kultur- und techniksoziologischen Rahmen verortet haben, die Möglichkeit gegeben werden diese in Form eines Aufsatzes einer breiteren wissenschaftlichen Öffentlichkeit zugänglich zu machen. Außerdem soll die Reihe aber auch als Plattform für den inhaltlichen Austausch mit KollegInnen dienen und steht insofern auch (Nachwuchs-)WissenschaftlerInnen anderer Universitäten und Instituten für die Veröffentlichung ihrer Arbeiten offen.

Eine soziologische Betrachtung von Technik zeichnet sich unter anderem dadurch aus, dass das Bedingungsverhältnis zwischen den technischen Artefakten und den sozialen Kontexten, in die jene eingebettet sind, als ein interdependentes - zu beiden Seiten hin gleichermaßen konstitutives - angesehen wird. Diesem Wesenszug soziologischer Perspektiven auf Technik trägt der Titel dieser Reihe Rechnung, insofern von einer kulturellen Einfärbung von Technik sowie - vice versa - eines Abfärbens von technikinhärenten Merkmalen auf das Soziale auszugehen ist. Darüber hinaus schieben sich zwischen den vielfältigen Kontexten der Forschung, Entwicklung, Herstellung, Gewährleistung und Nutzung zusätzliche Unschärfen ein, die den unterschiedlichen Schwerpunktsetzungen und Orientierungen dieser Kontexte geschuldet sind: In einer hochgradig ausdifferenzierten Gesellschaft ist das Verhältnis von Sozialem und Technik von je spezifischen Ent- und Rückbettungsdynamiken gekennzeichnet. Die vorliegende Working Paper Reihe möchte mit jeder Ausgabe einen kleinen Beitrag zur Klärung dieses verschlungenen Verhältnisses leisten.

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Die Herausgeber
Duisburg, im November 2010

How to understand the relation between technology and society better? A comparative analysis on three currently dominant perspectives on this intimate relationship in a techno-scientific society

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Keywords

Technological determinism, Technology as neutral tool, Constructivism, STS

Abstract

Technologies have the power to constitute and change our lives. Societies in turn build, (mis)use, keep or abandon and give meaning to technologies. How to understand the complex relationship between technology and society? This paper aims at introducing three currently dominant perspectives on the technology-society relationship: technological determinism, 'technology as neutral tool', and constructivism. By presenting some of their strengths as well as weaknesses, this paper is intended to provide an introductory understanding of different theoretical approaches to technology and society.

Introduction

Can you imagine a morning without a cup of coffee or tea? Without newspapers, internet, radio or TV? Which means of transportation do you use to go to school or work - how do you work at all, if not with a pen, paper, personal computer, etc.? How to know if your friend, sister, employee or employer is doing well without making a quick call? Try (or better not) to go outside in the winter without any clothes: you will not only freeze and get sick but probably also get caught by the police being accused of exhibitionism, of suffering a mental disorder, and of violating the law of summary offence in terms of disorderly conduct. Technologies are supporting pillars of our cultural, political, economical and even spiritual lives. From the morning till the evening we are depending on technologies. Oftentimes we are so used to them that we are not even aware of them anymore unless the lack of technologies for example when a breakdown of a technological system occurs. Standing in front of an ATM, which says "Contemporarily out of order" can mean an existential problem when being alone abroad and under time pressure. Indeed, it is hardly imaginable, if not impossible, to live without any technologies at all.

Technologies have the power to constitute and change our lives. Societies in turn build, (mis)use, keep or abandon and give meaning to technologies. How to understand the complex relationship between technology and society? To answer this question, in this essay I will present three different perspectives.

In the following, my reader might feel as if he or she follows pendulum swings: the first swing directs to the perspective of "technological determinism", where I elaborate on the predominant power of technology over society. Secondly, the swing leads us to the perspective of "technology as neutral tool". In this section I will stress societies' power over the usage of technology but also technologies' imposition of leading technological change. Finally, the pendulum finds more balance with the perspective of "Constructivism", where I will explain its basic tenets and aims. In each section I will provide detailed descriptions of the theories and their strengths as well as weaknesses. In doing so, I will provide diverse examples such as metaphors, debates and even comic strips to attempt in the best way possible that my explanations are traceable for any kind of interested reader. An example of the currently developing service robotics technology will appear in all three sections in order to highlight the crucial differences of the diverse perspectives. In the end, I will be able to provide a broad picture of the diverse perspectives in STS studies[1].

I. Technological determinism: theory of technology and theory of society

> Given the pace of technology, I propose we leave math to the machines and go play outside. (Calvin and Hobbes[2])

When one has a look into newspapers or mass media the most popular and common account of technologies is what in STS is referred to as "technological determinism". Technological determinism is an explanatory framework which is subdivided into a theory

[1] STS is a dynamic interdisciplinary field, which is "a result of the intersections of work by sociologists, historians, philosophers, anthropologists, and others studying the processes and outcomes of science, including medical science, and technology." (Sismondo 2010: vii) In section three, I will elaborate more extensively on the current position of the STS perspective.

[2] Source: Watterson, B. (1992) *Calvin and Hobbes*, distributed by Universal Press Syndicate.

of technology and a theory of society. In the following I will present both theories in their strongest or hardest[3] sense.

According to Mackenzie and Wajcman, the theory of technology proposes that technological development is independent of society, a "simple cause-and-effect theory" (1999: 4). This means that technology develops autonomously outside of society by following its own inner logic. It can be argued that the theory of society is based on the theory of technology. The theory of society proposes that technology is the primary determent factor that has an effect on society, or in other words that the only source of societal change derives from technology per se. In this view, technologies seem to come automatic, just as the next logical step to occur to society. Society has no choice than to adapt to technological change. Winner's definition on technological determinism can be seen as a theory of society, in which he presents two hypotheses: "(1) that the technological base of a society is the fundamental condition affecting all patterns of social existence and (2) that changes in technology are the single most important source of change in society." (1992: 76) A common metaphor that combines both the theory of technology and the theory of society is that of a train: the train (technology) itself (autonomous character of technology) runs unstoppably on its track (following its own inner logic), a track, once set, which cannot be moved or shifted a millimetre to the right or left. Once the train departs it causes action and effects on the passengers (society) if and when to catch a ride (simple cause-and-effect-theory) - if the passengers are too late, the train is gone. If the train is too slow, the passengers will have to wait. Simply put, technology acts and determines society; society has "to adapt, to protest or to run away". (Bijker, September 2010, lecture)

To the critical reader it becomes apparent that technological determinism is a radical and reductionist theory in explaining the relationship between technology and society. There are clearly problems involved. First of all, in technological determinism technology seems to act as a metronome: unrelentingly, irreversibly and ineluctably setting the rhythm to society. Technology's role in this model is quasi self-explanatory and refuses the possibility to analyse the process behind technological change "juggernaut-like" (McGinn 1991: 72)

[3] Technological determinism is often categorized into "soft" and "hard" determinism. For further information see in MacKenzie/Wajcman (1999: 4).

due to the idea of the inner logic. Secondly, technological determinism undermines the notion that society has any power to impact on technological change. Society seems to be confined to technology's steady march into social spheres. Mackenzie and Wajcman stress the problem of the underlying passivity of society's role: "[t]he view that technology just changes, either following science or of its own accord, promotes a passive attitude to technological change. It focuses our minds on how to adapt to technological change, not how to shape it." (1999: 5) Along with this passivity come the neglect of human choice, the possibility and necessity of public discussions of and participation in technological change. Furthermore, ethical concerns and politics do not have any use in this model. This becomes highly problematic, because it leads to political debilitation, which means that "there is neither need nor the possibility for political deliberation" (Bijker, September 2010, lecture) if technology is ought to be seen as the ultimate and autonomous driver of societal change. Or in the words of Dusek: "[t]he claim that technology is autonomous is the claim that technology is independent of human control or decision." (2006: 105)

However, technological determinism should not be dismissed easily. It serves well as an explanatory framework to understand how technological development is most commonly perceived and experienced in society. In Germany, for instance, the new emerging service robotics technology is currently presented in mass media as the technology standing on the threshold to society and is prompt to diffuse into elder care institutions as soon as the technology is mature enough. Titles as "Roboter in der Altenpflege."[4], "Roboter tröstet genauso gut wie echter Hund."[5], "Care-o-bot: Pfleger aus Stahl"[6] indicate either a full blown negative or positive view on service robotics technology. On the one end of the dichotomous axis, service robots are equaled with a threat to humanity, while depicting the future elder care institutions as cold and mechanized living environments, a value free zone where human contact has perished due to the unstoppable robots which eventually will replace the job of geriatric nurses. Simultaneously, on the other end of the axis the

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4 *Robots in the geriatric care.* Kölner Stadtanzeiger. *Roboter in der Altenpflege.* (Evelyn Binder), *19.09.2009.* http://www.ksta.de/html/artikel/1253287287695.shtml

5 *Robot comforts as good as a real dog.* Spiegel online. *Roboter tröstet genauso gut wie echter Hund.* (hda), 28.02.2008. http://www.spiegel.de/wissenschaft/mensch/0,1518,538305,00.html

6 *Care-o-bot: a nurse made of steel.* Planet Wissen. (Michael Ringelsiep), 28.10.2009. http://www.planet-wissen.de/natur_technik/computer_und_roboter/roboter/pflegeroboter.jsp

same technology is represented as being the savior for the increasing inhuman conditions in elder care institutions.[7] Here, it is stressed that the relief through service robots will lead (paradoxically as it might sound at first sight) to a more human living environment, in which geriatric nurses will gain in time and be more dedicative to elderly. This example shows not only the optimistic or pessimistic visions on service robotics in mass media, but -more importantly- that technological determinism is still wide spread in common sense: both accounts already present the technology under development as already existing. Robots are not yet "in" the geriatric care - they are in many minds and in some laboratories. Nor are they comforting as a real dog or not capable to act as a nurse. The fact that in mass media robots are made to exist in social places before they in reality do contributes to the common idea that technologies develop autonomously, following an inner logic, and will eventually diffuse into and act upon society, either for good or bad. Ethical concerns whether the robot is desired to interact with elderly in an elder care institution, or impose a threat to geriatric nurses work place, seem to be futile in this explanatory framework.

Regarding the common perception of technologies' steady march into society, it should be noted that it is not only that of uneducated public or laymen, but also from highly educated and leading figures of the high-tech world, the so-called digerati (the elite of the Internet and information technology world). Bill Joy[8] and Ray Kurzweil[9] fiercely argued about the idea of technological progress and their diverging visions about the next generation technologies of genetic engineering, nanotechnology and robotics (GNR). Service robotics can be assessed as the preliminary stage of the next generation technologies especially with regard to the robotics development. In providing their arguments, Joy stresses the posing threat of GNR's to the future of humanity whereas Kurzweil illustrates the opportunities that GNR can offer to humankind. Joy's future vision seems to be as pessimistic in the extreme just as Kurzweils' is optimistic. It can be argued that both share some ideas of technological determinism: Joy states in his article Why the Future Doesn't need Us that

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7 Geriatric nurses complain over work overload and time pressure leading to inadequate care for elderly triggered by the current problematic demographic shift.

8 Bill Joy is the cofounder, chief scientist, corporative executive officer of Sun Microsystems, principal designer of UNIX and developer of JAVA programming language, and since 1997 he was appointed as co-chairman of the President's Information Technology Advisory Committee.

9 Ray Kurzweil is known as author, inventor and innovator, founded and developed business among others in fields of artificial intelligence.

technological development occurs unchecked, that self-replicating technologies as GNR will be in effective control on humans, and that technological progress can take a life of its own: "[W]e have long been driven by the overarching desire to know that is the nature of science's quest, not stopping to notice that the progress to newer and more powerful technologies can take a life of its own." (Joy in Teich 2006: 122) His suggestion is to understand the high-speed technological drive and to try to counteract in being more presciently "as to do the right thing only at last may lose the chance to do it at all." (ibid: 132) In its response to Joy, Kurzweil explains technological progress in terms of "exponential rates" (ibid: 147): the evolutionary process of historical development of technology displays a "law of accelerating returns, which explained why technology evolves in an exponential fashion." (ibid: 148) Thus, Kurzweil argues that technological progress as inevitable: "We have no choice but to work hard to apply these quickening technologies to advance human values" (Kurzweil in Teich 2006: 163). Here, the problem of technological determinism comes apparent: if there is no choice to impact on technological development, there is no responsibility to be taken; in fact, there is even no need to discuss technological progress and potential ethical, political or any issues at all.

To summarize, we have encountered technological determinism (in its theory of society and theory of technology) with the example of media representations of service robotics and Joy's and Kurzweil's discussion about GNR development. Technological determinism as an explanatory framework offers the possibility to understand how technological development and change is commonly perceived in society, when taken as a whole. Technological determinism stresses the dominant role of technology in society, yet it is highly problematic in its implicit denial for human choice and responsibility. Furthermore, it does not provide any space to reflect on the inherent character of the process of technological development. Given its problematic implications discussed, technological determinism can be evaluated as a rather one-sided, reductionist and radical theory in explaining the relationship between technology and society.

After having pointed out the problematic issues of technological determinism, there is a need to find another perspective to understand in a more substantial way the relation between technology and society. Seen the lack of societies impact on technology, the

swing consequently moves towards the social sphere. In the following section, we will encounter "technology as neutral tool", a perspective to which it is also referred to as "social determinism".

II. Technology as neutral tool

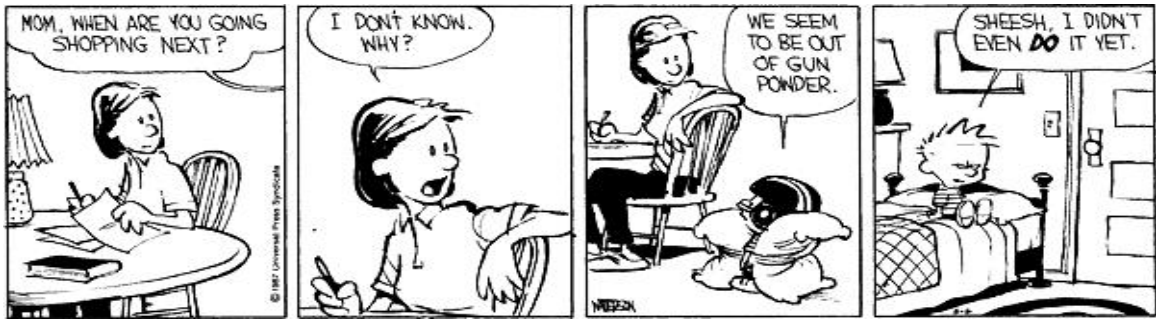

Fig. 1: Calvin and Hobbes: On Gunpowder

Without any doubt, we are depending on technologies, as discussed earlier. But this is only one side of the coin. What would technologies mean after all if no one is there to use or to avoid them? Users of technological artifacts are the ones who make them "alive" by making sense of them and choosing whether or not to use them. Without human interaction, technologies would silently exist unheard, untouched, unnoticed. Also, the idea of technological determinism that "progress happens" (Kurzweil in Teich 2006: 149) is at odds when one considers that technologies themselves cannot affect societies if there were no choices, regulations and decisions made to use them (unless they are not replicative, which is still the case of current technologies). This kind of perspective to technology and society is in STS referred to as "technology as neutral tool". "Technology as neutral tool" is another explanatory framework which stresses predominantly the social side of technological change. In this view technology (as the name already suggests), is a neutral instrument up to user's intentions and usage. One metaphor to explain this perspective is that of a gun. As the cartoon of Calvin and Hobbes illustrates in figure one, the gun itself cannot do any harm if no one is there to pull the trigger. However, the reaction of Calvin's mother is to seclude him in his room. This educative measurement reflects also that the mother chooses to protect her child to do any harm with the gun, since it would be

Calvin's, or more precisely his mother's fault, thus her responsibility if anything goes wrong - it is not the responsibility of the gun itself. Thus, technology has in this perspective no explicit, straightforward or intentional effect on society. The effect that occurs through the usage of a technological artifact is the result of human choice and action. The advantage of this perspective over technological determinism is that it "gives a prominent place to people, individually and in groups, making choices about how they want to use the technical artifact." (Wyatt 1998: 13)

However, there are still stinging thorns: the problem of "technology as neutral tool" is that it still sees technology and society as two distinct spheres. Why this is problematic will soon become clear. To begin with, the idea of technology is still identical with the first part of technological determinism (theory of technology) that technological development occurs autonomously by following its own inner logic, free from any social impositions. A short detour to the previous metaphor of comparing technology with a metronome might clarify the distinction between the two perspectives discussed and their problematic issues involved. From the technological determinist point of view, the metronome still inexorably, irreversibly and ineluctably sets the rhythm to the piano player (in this sense, the user) who has to adapt or to run away; from the perspective "technology as neutral tool", the metronome is still imposing the rhythm but it is the piano player who uses the rhythm to try to play properly. The important distinction here is that not the metronome (nor the instrument by itself) makes the music, but it is the piano player who does it. If he is talented, the playing are synchronized with the rhythm, if he is too slow or too fast or even unskilled or just bored, well then his playing sound awful, and the audience (society) will not sit still and adapt to his playing or follow the unrelentingly metronome but most likely protest and/or run away. The credit for the players' success or failure goes to the player himself, not to the metronome or the instrument, a point which underlines the responsibility of the user towards a technology. Here becomes also another distinction to technological determinism apparent: regardless if the technology works or not, as skillful as the user might be, the user is the one going to be blamed or cherished, not the technology per se.

Now, in the case of service robotics, technology as neutral tool, does not question the idea that service robotics will eventually be available in society, if the technology is technically

mature and ready. However, it does question whether or not to install service robotics in elder care institutions at all and if so how to do it best, because the implementation of a technology is a matter to be decided upon. There open up two possibilities: if it is decided to install service robotics in elder care facilities, from this point on all the responsibility that comes along with the technology (i.e. use and misuse, technological functioning, and future impacts of societal change (not technological change, since it is independent from social impact)) is assigned to society at large and to the individual user. In turn, if it is decided to leave service robotics in the laboratories and in peoples' minds, the question of responsibility does not end simply with rejection either: society has to take position why this technology is not going to be implemented, explain why it is thought of to be the best decision for all, etc. Already here it becomes difficult to understand what 'best' means: "the technology that is "best" from one point of view is not necessarily the best from another" (Mackenzie and Wajcman 1999: 19). This argument is usually made to counteract technological determinism, because the idea that for example what is best for pupils (i.e. Wikipedia) might not be best for teachers, and so the diversity of technical desirability comes to the fore. But here, with "technology as neutral tool", not only the diversity of opinions is the crux, but also the underlying societies' obligation to take position if and why it opens or not the doors to (the inner logic of) new emerging technologies. Very simply put, technology appears (i.e. service robots), society has to react.

Strictly seen, it can be argued that the perspective of "technology as neutral tool" can even restrict society more than in technological determinism in two ways: by assigning responsibility to society over technology it presumes that society has to bear the consequences not only for misusage (whether intentionally or not) of technological artifacts but also for technological malfunction. Instead, in technological determinism, any misusage or malfunction of technology is ascribed solely to technology itself. Both theories lack a balanced and adequate account on technological change and the question of responsibility. Concluding, technology as neutral tool, as much as it appraises its strong social side of explaining technological change, it underscores the impact in which society has nonetheless to adapt to technologies' inner logic, speed and obligatory demand for appropriate handling.

After having pointed out the problematic issues of both technological determinism and "technology as neutral tool" the need rises again to find another more adequate and substantial perspective, one that does not treat technology and society as two distinct spheres, but which looks deeper into the very process in which society and technology interact.

III. Constructivism

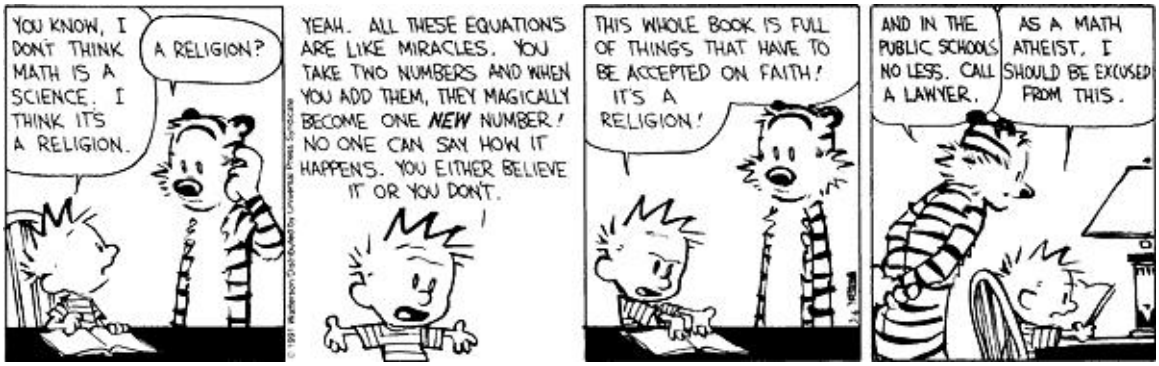

Fig.2: Calvin and Hobbes: Science is a Religion

Since the 1980s in the realm of STS, the constructivist perspective on science, technology and society has become increasingly adopted by scholars of many diverse disciplines and fields inspired by previous experiences of the Sociology of Knowledge Studies (Jäger n.d.: 5). Generally speaking, STS starts from the assumption that "science and technology are thoroughly social activities" (Sismondo 2010: 10), which means that social shaping of technology is taken as a starting point of critical analyses - also referred to as social constructivism. Scholars came to an agreement that "scientific facts are constructed in a social context." (Jaeger n.d.: 6) Constructivism implies that behind every scientific claim or technological artifact stands a community of scientists and engineers who themselves are trained by specific schools with special focuses, desires and aims. Hence, "there is no abstract and logical scientific method apart from evolving community norms." (Sismondo 2010: 11) Furthermore, social skills are also interplaying such as building up a reliable reputation or an intelligent use of rhetorics to convince others of the apparent validity of one’s (or one groups) idea or claim. So neither science nor society or technology are simply ’there’, distinct, independent spheres, rather they are heterogeneous, mutually

evolving and each other shaping systems, which are profoundly interrelated, "in a web of social relations" (Mesman, September 2010, lecture). The method of constructivist analysis is based on different social disciplines. A critical examination of all the factors involved in science, technology and society reveal an "inherently value-laden, multifaceted, and complex process [...]" (Cutcliffe 2000: 114). Thus, the separation between these three spheres as technological determinism and "technology as neutral tool" draws them is no longer feasible in the constructivist perspective. Unlike the example of Calvin and Hobbes in figure two, the constructivist perspective does not place science as a religion, which simply has to be accepted on faith. Constructivism instead describes the "complex, heterogeneous ensemble of technical, social, political, economical, cultural elements, where the definition of what is social, technical, etc. is not given a priori, but emerges as a result of the mutually shaping process." (MA ESST Course book 2010: 25) The aim of constructivism is to understand the relation between society and technology context based. The basic tenet of this perspective is that science and technology are embedded in social institutions and is affected by power relationships as well as resource distributions. (Mesman, September 2010, lecture) Furthermore, constructivism enables political reflections by following democratic goals- contrary to technological determinism and "technology as neutral tool".

Once, one accepts the idea that technologies are socially constructed, this perspective opens up new alternatives of understanding technological development. First of all, constructivism denies the idea of right or wrong, success or failure, by following the "principle of symmetry". Symmetry in STS means that either success or failure of an artifact depends on actors involved in the technological development but as well on certain groups of people and also individuals who perceive "right or wrong - success or failure" all differently (as I argued earlier in section two that there is not one "best" for everyone).

Secondly, unlike technological determinism and "technology as neutral tool", constructivism denies as well the theory of technology, the idea of "inner logic" and "autonomous development" by making the argument of "contingency": if other actors were involved in a technological development, then the outcome could have been - to a certain extent - otherwise. The current service robot prototype "Care-o-bot III" is an attempt of a group of

engineers and designers who are co-working to meet social demands with technical feasibility. Each and every one of them perceives the idea of social demands differently (depending on cultural backgrounds, gender, ethnicity, etc.) and each and one of them has different ideas and preferences to tackle the challenge. Consequently, Care-o-bot III could have been otherwise, if instead of Mrs. Müller, Mr. Schmitz would have been in charge of Care-o-bot III's design.

Thirdly, contrarily to technological determinism and "technology as neutral tool", constructivism understands the social process of technological development as collective, open and in continuous, non-linear fashion, even after the technological artifact has left the prototype stage and the fabric halls. This means that "[n]o technology - and in fact object - has only one potential use" (Sismondo 2010: 98); which is usually an argument made against the standard idea that technology drives history. In the case of Care-o-bot III, it means that it no longer depends on Mr. Schmitz or Mrs. Müller alone, but also on the way users think of and use the artifact. Care-o-bot III can be used as a functional robo-butler serving beverages but it can be used as well as a high-tech prestige object with the intention to increase the reputation of a care institution. Thus, the end product is an emergent phenomenon born out of social, political, economical and technical relations.

The constructivist perspective seems to be most adequate in studying the relation between not only technology and society but also science. However, also the constructivist perspective has certain weaknesses as well. For example, it is often accused of not taking any position towards normativity. Hans Radder, a professor of philosophy of science and technology at Vrije Universiteit Amsterdam, criticizes the lack of normative reflections in constructivist approaches, which he finds paradoxical since constructivism is not normatively neutral: "It has also been claimed that social constructivism has normatively relevant implications for technology." (Bijker/Pinch in Radder 1996: 96). This becomes logical when one follows the argumentation of Steve Woolgar, a british sociologist, who starts from the premise that constructivist studies of science show that "the objects do not determine their representations but that it is the other way round: the representations determine the objects. More precisely, the representations are objects, and representation is all there is." (Woolgar in Radder 1996: 98) Now, to come back on firm grounds: what does this explicit-

ly mean for constructivism? Well, this is an explicit critique on the interpretation of constructivist's own research activities: constructivists may be accused of not only taking the normative account and the 'impact question' sufficiently into consideration, but also that they are "remarkably close to a very standard view of science: they simply report what they "see", whereas values come into play only afterwards, in the "application" of the results by different parties." (ibid: 97) For constructivists it seems most importantly to lay first the ground at all with the rather radical claim that representations and realities are socially constructed and that they are real social objects. (Sismondo 2010: 60)

The notions of normativity, representations and objects leads to another fierce debate going between realists and constructivists: Whereas realism "typically amounts to an intuition that truths are more dependent upon the natural world than upon the people who articulate them" (Sismondo 2010: 58), constructivism takes the counter position in stating that reality is socially constructed, that "[r]ealities, institutions, and structures come to exist because of people's actions and attitudes." (ibid: 60). Realism's different starting point of explaining the world cannot be dismissed easily by constructivism, since there is uncertainty about where natural kinds belong to, the non-human or rather human classification? The question if the color red is the same for everyone cannot be answered with certainty just philosophised upon. Hence, realists criticises constructivists to make sense of the world by human impositions - "[w]hen scientists agree on a claim, they literally make the claim true" (ibid: 68) -, whereas realism believes that the features of the world are real, outside of human subjectivity, a priori given.

Concluding this section, so far I have explained the basic tenets, aims and objects of constructivism by pointing out some crucial differences and advantages on technological determinism and "technology as neutral tool". Furthermore, I have related the principle ideas to the example of the service robot technology.[10] The last part focused on the

[10] It should be mentioned at least that yet, to study the seamless web of science, technology and society, there are three different approaches within the STS program: the Large Technological Systems approach (LTS, mainly developed by Thomas Hughes), the Actor-Network approach (ANT, developed by Bruno Latour, Michael Callon and John Law), and the Social Construction of Technology (SCOT, draws upon the ideas of Wiebe E. Bijker and Trevor Pinch). To explain these different approaches might be fruitful at this point, however this would go beyond the scope of this essay since my research question focuses on outlining the three perspectives discussed, and to provide a comparative analysis between those.

weaknesses of constructivism such as the lack of normativity and its critical stand in philosophical debates.

Conclusion

In this essay I have discussed three different perspectives to study the relationship between society and technology. Technological determinism unveiled an account on how commonly technological change is perceived in society, no matter if laymen or experts as the example of Joy and Kurzweil reflected. However, this perspective proved major weaknesses in explaining the social impact in technological development; quite contrarily to "technology as neutral tool" which underlined the social sphere, although it does not deny the theory of technology. Both perspectives treat society and technology as two distinct spheres, which is since two decades heavily criticised in STS. Thus, constructivism, as the last perspective introduced, underlined the social shaping of technology, by denying the inner logic of technology and by approving its contingency. In constructivism, the separation between spheres is dissolved. However, also constructivism does not pass without some critiques: the exclusion of the ’impact question’ should be elaborated on in doing further research with empirical case studies and participation in philosophical debates.

Perspectives are, in any case, like glasses to look through to make sense of the world. The question is: how to find the most appropriate pair of glasses for most of the people?

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