Field 1: From social to critical constructivism

This comprehensive field explores the constructivist tradition in the field of science, technology and society. The inquiry focuses on subject position's construction and uses it as an entry point into a discussion about the political implications of technology. Subject position is thus the first step of a larger reflection on technology and the societal control of it.

The aim of this inquiry is to understand how identities are constructed through the production, dissemination and use of technology, conceived here as apparatuses (physical devices of technical performance) and techniques (routines, goal oriented activities, purposive human actions) (Winner, 1978). Some of the questions inspiring this research, and to which I aim to provide an answer, include:

- In which ways does the technological ensemble into which we are born shape our subjectivities?
- To which extent can we express our identities through technological control?
- What are the elements mediating individuals' production and consumption of technologies?

The research begins with a review of two of the main school of thought in the field of science and technology studies of the 80s, namely Social Construction of Technology (SCOT) (Oudshoorn & Pinch, 2003; T. Pinch, 1993; T. J. Pinch & Bijker, 1984) and Actor-Network Theory (ANT) (Latour, 1992; Latour & Woolgar, 1986; Law, 1991; Law & Hassard, 1999), and eventually discusses the transition from social to critical constructivism (Feenberg, 1999, 2002, 2010). In particular, this field focuses on the possibility to develop a new understanding of the relation between subjectivity and technology by reevaluating the ANT vocabulary in conjunction with Foucault's analysis of discursive formations. In this respect, I am convinced that Actor-

Network Theory can be a useful method for analyzing the translations of power across humans and non-humans actants. The analysis of discursive formations, instead, can be helpful in contextualizing these networks of translations within the specific *discursive formations, and the overarching episteme,* into which they occur (Foucault, 1972, p. 191). Before delving into discussion about ANT and Foucault, in the following section is provided an overview of constructivist approach to technology, followed by a discussion of its limitations.

Technology and society: the constructivist turn

In questioning the relation existing between society and technology, two opposite and extreme positions can be readily identified. On the one side of the debate we find all those traditions which built on a Baconian understanding of science and technology. This position conceives technology and science as means for humanity to tame and control nature. This *instrumental* approach sees technology as human-controlled and *essentially* neutral. The ends pursued through it, and the associated responsibilities, depend exclusively on humans' use of technology. Against pure instrumentalism, substantivism, argues that means and ends are intimately connected in technological development. Not only, due of their inner complexity, extension and ubiquity, modern technological systems would be unfathomable and uncontrollable, thus subverting the power relation between master and servant as posited by instrumentalism. According to Heidegger (1977), modern technology is a not neutral instrument but instead is a mode of revealing, i.e. an invitation for us to see nature as a resource to be exploited. In particular, technology offers us a way to manipulate and order nature so that we can demand and extract more from it. However, in doing that, modern technology does not act as a neutral means of control. The ordering of nature perpetuated through technology would not be the reflection of unconstrained human agency and technical mastery. Instead, it is the effect of

enframing i.e. the irresistible call of modern technology that compels us to reveal the real as standing reserve, i.e. "as a mere stockpile of forces" ready to be consumed (O'Brien, 2004, p. 31). Thus, modern technology, precluding all other forms of revealing and challenging humans to take part to this ordering, would eventually turn humanity itself into standing reserve.

Beyond pure instrumentalism and the dystopic futures of substantivism, several new approaches to science and technology developed in the second half of XX Century. These perspectives challenged the traditional view of science and technology as autonomous fields and studied them as institutions of society like all others. This range of theories, which I now identify with the broad label "Constructivism", traces its roots to the "Empirical Programme Of Relativism" (EPOR), a branch in the sociology of knowledge which focuses on controversies and knowledge production in *hard sciences*. From EPOR, constructivism borrows the principle of symmetry, according to which scientific facts are open to more than one interpretation. Instead of analyzing the alternative solutions of scientific disputes on the basis of their scientific plausibility, EPOR investigates the social relations undergirding all the alternative solutions regardless of their supposed "truth" or "falsehood". Through the principle of symmetry, EPOR removes aprioristic, and supposedly natural, distinctions between *true* and *false* in the evaluation of scientific facts. Instead, through the analysis of the social arrangements surrounding scientific disputes, EPOR explains how the *natural* categories of *true* and *false* are socially constructed. As a consequence of the removal of a clear-cut and *naturally sanctioned* distinction between true and false, all scientific facts would be underdetermined, i.e. they would not be univocally determined by *nature* but instead are open to more than one *social* explanation. Social constructivism transposed these two founding ideas, underdetermination and the principle of symmetry, to the field of technology studies. Against the instrumental positions, constructivism

argues that the meaning of technologies and the motives beyond their production, diffusion and use should be sought not only in the technical realm, but also, and mainly, in the historical and social specificities into which they are developed. Moreover, technologies should not be analyzed based on supposedly universal concepts such efficiency, functionality, usefulness. Instead, all for each given technical dispute all potentials solutions should be subject to the same kind of social investigation.

Several branches developed under the umbrella term "Constructivism", as used in this paper, and all in close relation. The most popular and one of the first is Social Construction Of Technology, developed by Trevor Pinch and Wiebe Bijker (Bijker et al., 2012). This approach looks at how "relevant social groups", usually engineers, consumers and technicians, can influence the developmental path of technology by interpreting the same technical object from different perspectives. Clashing interpretations over the functionality of a technology can generate disputes which are usually resolved through persuasion or problem redefinition. The settlement of the dispute determines the closure of the technology, i.e. the stabilization of its meaning. Closure also removes from sight the social intricacies between social groups which precede stabilization. Therefore, ex-post analysis of technologies, missing these social nuances, can only provide partial and often exquisitely technical explanations of technological development.

Critiques to SCOT argued that while relativizing the role of the technical, this approach over-emphasized the relevance of the social (Kline & Pinch, 1996). Moreover, SCOT inspired researches were criticized for ignoring the contribution that invisible and minority groups have in technological development (Kammen, 2003). Actor-Network Theory (ANT), an alternative theory in the constructivist tradition, seemed to offer an answer to these critiques.

Actor-network Theory is based on two provocative and quaint ontological claims. The first one is the abolition of any distinction between objects and people (Latour, 1994). In doing so, it applies the neutral term of "agent" to both humans and things, overcoming distinctions between intentionality (a term previously reserved for humans) and causal power (a term previously reserved for artifacts). This equivalence between humans and non-humans, known as the “second symmetry” principle, works alongside the one inherited from EPOR.

The second ontological claim consists by the total reliance on the basic metaphor of the network. All actors, whether they are human or non-human, can equally construct, or be enrolled into, networks of relations. Unlike the common technical understanding of *network* (e.g. as used in computer science or graph theory), in ANT *network* symbolizes the way in which actors gain significance and manage power (Latour, 1996). Unlike SCOT, ANT sees stable technologies not as the outcome of individual's interpretations technical artifacts. Instead, technologies, their functionalities and meanings are constructed through assembling and constantly reassembling heterogeneous networks of actants. Actors do not interpret technical artifacts but construct them through their actions and enforce them by enrolling other actants. However, throughout the process of enrollment and reinforcement, they also construct themselves, i.e. they shape their identity and their role within the network.

The equivalence between human and non-human thus helps to understand how users and technologies enter in a process of coevolution, oftentimes leading to the birth of new hybrid actants, themselves composed of further actor-networks. It also cast a light on the ways through which power flows through actants, how it is translated by humans and transposed over different space and timescales by means of technological artifacts.

Transition to critical constructivism

Theories in the constructivist tradition have been criticized for their incapacity to explore the political implications of technological development. Alongside the aforementioned critiques to SCOT, Feenberg insists on the implications that the principles of symmetry can have in neutralizing the political dimension of technology. The critique stresses the need to reevaluate and appreciate the nature of the social conflict associated with each different technological choice (Feenberg, 1999). Similarly, ANT has been criticized for its tendency to analyses the ordering of power simplistically, with the consequence of potentially naturalizing existing systems of discriminations and power imbalances (Alcadipani & Hassard, 2010). Moreover, because of its ontological commitments, ANT has often been attacked for its agnosticism towards socio-historical formations like capitalism (Roberts, 2012).

Despite all these shortcomings, constructivism has also advanced some ideas in the study of technology which are worth of recognition: the focus on materiality, the attention towards historical idiosyncrasies and contingencies, and the relativization of the technical domain. All these elements can be recuperated if properly framed within a critical theory of technology and society. Critical constructivism (Feenberg, 2010) tries to achieve this objective by: 1. Framing technologies within the specific socio-historical formations into which they develop and 2. developing a formal critique to the rationality which inform technological development.

Critical constructivism thus borrows from substantivism the idea that technology is not merely a tool. Technologies structure our world and define who we are. However, who we are and what we can be is not defined univocally by current socio-technical arrangements. People can challenge technologies, modify them at their will and transform the same arrangements which define them as *users of technology* in the very first place.

From instrumentalism, critical constructivism borrows the denial of fatalism and maintains a permissive stance towards technological development. At the same time, it remains wary in front of the supposed neutrality of technology. Instead, is argues that technologies realize the values of the rationality into which they are developed. A rationality which is not transcendental and absolute, even though we might experience it as such. However, through users' intervention in the design in the use of technologies, we, the users, can not only challenge the material artifacts, but also the associated values. Technology is thus a means of confrontation rather than a means of pure subjugation. A nexus where the values brought forth by users, designers and everyone affected by technology confront each other. If considered in this manner, technology can be seen an arena for democratic debate and, as such, it should be rendered inclusive.

A critical ANT?

How to advance the critical constructivist agenda? One of the possibilities, the one explored in this review, is through a recuperation of ANT vocabulary, coupled with Foucauldian analysis of discursive formations, and with a particular attention towards technologically constructed subjectivities.

In the constructivist tradition, the focus on technologically mediated subjectivities coincides with the shift from the analysis of technology in itself, to the analysis of technology "in use". Woolgar's *configured user* (1990) drew the attention to the process through which experts try to include users (or amateurish representations of them) into technological design, with the aim of limiting the interpretative flexibility of technical apparatuses (T. J. Pinch & Bijker, 1984, p. 21). Woolgar's idea of *configuration* was later complemented by Akrich and Latour's idea of script, which posits a two-sided process of technological *inscription* and *de-scription*. Through

inscription, designers translate their *program of action* into the design of a technology which, while favoring some specific uses, by no means determines the way in which users *de-script* the technology. This perspective reevaluated the active role that users can have in developing new and unanticipated applications of technical apparatuses. Lastly, Michel Callon (1986) provides a clear model of how identities circulate within networks of human and non-human actants. The main phases in this process are two: *problematization* and *interessement*. The former refers to the possibility, for each actant within a network, to projects and assign identities to other nodes according to a specific strategy. The latter, *interessement*, describes how identities are eventually enforced through devices (apparatuses, techniques, etc.) which further a specific *problematization* to the Actor-Network. Each actant can thus be enrolled into the strategy or, on the contrary, resist the original *problematization* and define new identities, goals, and means of consolidation of their own strategy. *Interessement* is therefore a power *translation* process (Latour, 1994), in which values and norms of the ordering nodes are translated into technical specifications and further prescribed (Latour, 1992) on other actants, whether they are humans or non-humans.

While Actor-Network Theory is very effective in explaining how some *problematizations* get enforced and persist over time, the same cannot be said about its capability to investigate on the sources of these strategies. Why actants problematize, assign identities and enroll delegates in a certain way and not in others? These questions recall the critiques expressed above, namely the agnosticism of ANT towards the socio-economic formations into which Actor-Networks develop. In trying to overcome what I conceive as a limitation of this theory, I propose to further the critical constructivist agenda by stretching ANT's commitment to consider the world

exclusively in terms of connected actants, and by connecting it with Foucault's analysis of discursive formation.

Actor-Network Theory and Foucault's analysis of discursive formation

Starting from Deleuze's interpretation of Foucault (1988), visible and articulable are two kind of practical formations: the former is discursive and is the locus of the statements, the latter is non-discursive and is the site of visibilities. Each age is characterized by a peculiar configuration of visible and articulable. The force bounding together form of expression (the articulable) and of content (the visible) is knowledge, and each age is thus defined by the way in which knowledge combines visible and articulable into mechanisms. In the often-mentioned history of crime, Foucault explains how the visible, the prison, existed to display criminality, while the articulable, penal law, created criminality as a condition for the existence of the prison. These two forms were articulated into the mechanism of the panopticon. The relation between visible and articulable, between form of expression and content, is not a deterministic one. The two forms are irreducible, therefore the visible is not the signified of the articulable, however they are brought into coadaptation by knowledge (Deleuze, 1988).

In order to understand why discourse can be relevant for interpreting technology, it is necessary to investigate its constitutive element: the statement. A statement is a function connecting concepts and subjects according to some specific rules of formation. The peculiarity of statements is that objects, subjects and modalities of enunciations are intrinsic to the statement itself, therefore each statement is uniquely determined by the combination of these three elements. Taken together in their heterogeneity, statements entailing different objects or concepts configure different strategies. A discursive formation is then identified if it possible to show that different strategies derive from the same system of formation. Strategies can be further analyzed

in their relation to other strategies belonging to different discursive formations. These connections between discourses constitute what Foucault calls the *episteme*. The *episteme* has no substance but is rather the sum of all the interconnections between the different rules of formation (also known as *positivities*) existing in different discourses.

If we now turn our attention to the non-discursive milieu, the visible, we can create a connection between technology and discourse. Visibilities, the analogous of statements in the non-discursive, are not things in themselves or perceptible properties of objects. Instead, they are forms of *luminosity*, objects that exist only under a certain light. Visibilities are therefore perceptible only through the conditions laid down for visibility by the discursive formation. The articulable modulates the light which is reflected by the visible (Deleuze, 1988).

Therefore, conceiving Actor-Networks as visibilities arranged by discourses can help us to move beyond a social constructivist understanding of technology, in which meaning is determined by social groups floating in a political void. Instead, the analysis of discursive formations would allow to explore the political dimension of ANT. Concepts such as *underdetermination*, *interessement*, *translation* and *ambivalence* can gain a new meaning if interpreted as the effect that different discourses can have in revealing different visibilities of the same non-discursive milieu. The meaning of a technology, the affordances it offers us, the subjectivities it prescribes, or that we circulate through *interessement*, can be reinterpreted through the discursive formations in which these networks of humans and non-humans actants develop.

My hopes are that through the combination of Actor-network Theory and analysis of discursive formation it could be possible not only to foreground the material conditions which allow for the creation and circulation of subject positions, but also to sharpen the critical

analytical edge of Actor-network Theory. I also hope that doing it using the pluralism of discursive formations, instead of the singularity of socio-economic formations (as done, for example, in Roberts, 2012), would allow us to appreciate the multiple ways in which the actors composing the visible are arranged by different and concomitant discourses.

Lastly, the analysis of discursive formations should nor replace ANT's "semiotics of materiality" (Law & Hetherington, 2000), nor complement it by providing a missing "social context". It should, instead, work in parallel but at the discursive level, explaining why a certain knowledge creates a specific statements' configuration and, consequently, unveils different aspect of materiality.

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