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Values, Politics, and Technosocial Systems:

A Critical Analysis of Value-Sensitive Design, the Social Construction of Technology, and Actor-Network Theory

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Area Exam Prompt:

> Scholars have long agreed that in some sense, as Langdon Winner put it, "technologies have politics." Yet, they have differed as to how. Scholars in the Social Construction of Technology and Actor-Network Theory camps, on the one hand, differ substantially from those working in the more HCI-oriented "values in design" community. In this essay, please compare and contrast these two traditions. How do scholars in these different camps say that values come to be built into designs? How do designs express or otherwise engage users with the value systems of their makers? In what ways are the research methods and insights of these two intellectual communities useful for scholars interested in the ways that computing machines might "have politics"? And what questions do they leave unanswered?
>
> Please draft an essay consisting of 6500 to 9000 words (roughly 25-35 pages), not including references, working from the reading list we agreed on and return it to me by email within one week of receiving this question.

Introduction: Politics and Technology, Designers and Users

How do technologies have politics? In this essay, I will critically examine three frameworks that specify how technologies come to have politics and how these politics interact with users. First, I will discuss popular approaches to answering these questions in human-computer interaction, particularly the Value-Sensitive Design framework. Then I will describe the theoretical framework of Social Construction of Technology, popular in Science and Technology Studies and the History of Science, and compare its strength in addressing these questions relative to Value-Sensitive Design. Finally, I will contrast both of these to the Actor-Network Theory approach, also popular in Science and Technology Studies, and explore some alternatives to these.

Four categories will recur throughout this narrative: politics, technology, users, and designers. To illustrate these categories, I turn to one of the earliest, and most-cited, discussions of the politics in technologies: Langdon Winner's aptly-named 1986 essay "Do Artifacts Have Politics?" (Winner, 1986). There, Winner describes how *technologies* – which could include any part of our built environment, from databases to tomato harvesters, mobile phones to freeway overpasses – can and do embody *politics*, which he describes as social conditions and power structures. Winner describes this embodiment an interplay between so-called technological and social determinism: *designers* create technologies, from nuclear reactors down to the "seemingly insignificant features on new machines" (p. 29), based on a mix of social practices and technical constraints. In turn, these technological artifacts can influence the lives and activities of *users*, broadly defined as the people using, displaced by, or otherwise touched by the technologies.

Winner outlines two ways in which these artifacts can embody political choices and implications. In some cases, the technology itself is inherently political: the very nature of atomic bombs and nuclear power necessitates strong, centralized management and security (Winner, 1986, pp. 19, 32-34). In other cases, the technology is flexible and a particular implementation of it is political, showing the prejudices (or perhaps the ignorance) of the designer (pp. 23-28). The apocryphal story of the low freeway overpasses on Long Island that prevent bus service to the public beaches (Woolgar and Cooper, 1999), or the true story of mechanical tomato harvesters in California putting tens of thousands of small farmers and migrant tomato pickers out of work (Winner, 1986, p. 26), illustrate how even seemingly-innocuous design choices can have resounding social ramifications.

Below, we will explore three theoretical frameworks designed to tease out the politics in technologies and their implications. We first turn to Value-Sensitive Design, popular in the field of human-computer interaction.

Human-Computer Interaction and the Politics of Values

Human-computer interaction (HCI) has long been interested in examining a particular kind of "politics" in the machine. In fact, the field as a whole is predicated on building technologies to have certain effects on users, generally focused on usability, the degree to which a technology is easy to use, understandable, and matches expectations (or "mental models"). From the perspective of critical social science, usability is inherently political – usable for whom, in what way, and with what implications? – but relatively few scholars in HCI have explicitly discussed these politicized aspects. In this section, I will focus on exploring the implications of the values approach to investigating

the politics of technologies. I will conclude by highlighting other nascent approaches in HCI that are more critical of the centrality of technology's role in everyday life, of finding technological solutions to problems, and of traditional approaches to designing technologies.

One often-referenced conception in HCI of the ways in which technology can be built to affect use is through *affordances*, or the perceived uses of an object – for example, chairs afford sitting and door handles afford pushing or pulling – which stem from both the design of the object itself and the experiences and expectations of the user (Norman, 1990). In *The Design of Everyday Things*, Donald Norman brings the idea of affordances to human-computer interaction, mentioning several politics-laden examples such as disabled access and ergonomics. However, Norman does not directly address the political implications of designing such features, instead simply encouraging designers to create affordances that correspond to unproblematized "commonsense" (though culturally-sensitive) understandings.

A more theoretically-developed body of literature concerning the politics of the machine in human-computer interaction comes from the discussion of "values," particularly the work from the Value-Sensitive Design (VSD) laboratory directed by Batya Friedman. VSD provides methodical and proactive input into the design of technologies by accounting for "human values" throughout the design process, where a value "refers to what a person or group of people consider important in life" (Friedman, Kahn, & Borning, 2006, p. 2). In particular, the VSD approach prefers to focus on human values of "moral import" as defined or identified by deontological and consequentialist moral philosophy (p. 13), such as privacy, informed consent, human welfare,

sustainability, and justice. VSD holds that "based on a large amount of psychological and anthropological data," these kinds of values are universally important, although their implementation and relative significance may vary culturally. Researchers can look both on the broad, abstract scale to identify these universal values and on the specific, concrete scale for cultural variations in them (p. 14).

Value-Sensitive Design also broadens the scope of those affected by a technology beyond those using the technology, or the "direct stakeholders," to the "indirect stakeholders," those affected by a technology but marginalized in design or use. In this way, VSD attempts to mitigate differences in power between various groups using or affected by a technology.

The values relevant to a particular group of stakeholders or implicated in the design of a particular technology or context of use can be defined conceptually, by developing robust theoretical models of the values that may be important to a particular group of stakeholders or in a particular technology, drawing on philosophy, psychology, anthropology, and other sources. They can also be explored empirically through examining current practices and technologies and evaluating new prototypes, potentially using "the entire range of qualitative and quantitative methods used in social science research" (p. 4). In this process, conflicts in values may be uncovered (for instance, between maximizing profit and accounting for employee well-being or environmental sustainability), which should be addressed with "a good deal of discussion" with various stakeholders to find a workable solution (p. 16).

Finally, the values identified can influence the design of new technologies, which are iteratively evaluated and adjusted to maximize their benefits and minimize their

harms, much like Participatory Design (Flanagan, Howe, & Nissenbaum, 2005). While the VSD theory does not theorize how values are specifically "built into" technology during each of these iterations, its practitioners provide various examples of how values influence system design. Friedman et al. describe how value explorations impacted the design of an urban simulation program called UrbanSim, and how they used a prototype system of a webcam connected to a plasma screen in a windowless room, called "Room with a View," to explore values (Friedman, Kahn, & Borning, 2006). Similarly, Flanagan *et al.* describe how to embed values in the design process through a case-study of Rapunsel, a game intended to teach middle-school girls about programming in the Java computer language (Flanagan, Howe, & Nissenbaum, 2005, pp. 8-25). In this piece in particular, Flanagan *et al.* discuss the design process itself, including the decision points and iterative evaluations that the researchers completed.

How do these values interact with stakeholders? According to VSD, the values that influence the design process are not "inscribed" into technologies directly, nor are they simply transmitted socially with the technology as a passive bystander. The ways that values interact with users parallels the ways that Norman's affordances interact with users (Norman, 1990): a technology may "more readily support certain values and hinder others," but this also depends on the "goals" of the people interacting with it (Friedman, Kahn, & Borning, 2006, p. 13). VSD holds that technologies may occasionally be rejected wholly, but more often they are iteratively used and redesigned based on user feedback, thus converging on an optimal solution given the priorities of the designers and various stakeholders.

Some VSD research doesn't interact with users directly but instead conducts a value-conscious analysis of technologies with an eye to generating design suggestions. For instance, one of the earlier papers in the VSD area was an investigation of the politics of search engines, then dominated by AltaVista and Yahoo!. It finds that the biases in these search engines are a mix of algorithmic blindness or limited scope (e.g. the page just wasn't known or indexed), strategies to reduce link spamming, economic motivations to highlight advertisers, and social-status motivations to sanitize content (Introna & Nissenbaum, 2000). It concludes with discussion of technical and regulatory forces to correct for the biases in algorithm and design. Friedman *et al.* also contribute a more general description of the types of bias typical in computer systems and suggestions for avoiding these biases (Friedman & Nissenbaum, 1996).

Focusing on "values" has become popular in human-computer interaction – indeed, Gilbert Cockton has suggested that following the "system-centered 70s," the "user-centered 80s," and the "context-centered 90s" could be a focus on values and design in HCI (Cockton, 2006),[1] and Michael Zimmer proposed that VSD be used in media ecology studies as well (Zimmer, 2005). Others in HCI have used VSD and similar frameworks in identifying values in the design of technologies, with some variations. For example, instead of using the values framework from VSD, Voida and Mynatt used a value taxonomy developed by social psychologist Milton Rockeach to identify and categorize family values in response to an adaptation of a "cultural probe," a toolkit to explore aspects of one's life or environment that are often taken for granted (Voida & Mynatt, 2005). Similarly, Hutchinson et al. deployed "technology probes," prototype-like

[1] However, Cockton has also quipped that "value" is an overloaded term, suggesting the use of "worth" instead (Cockton, 2006).

technologies like Friedman *et al.*'s "Room with a View," designed specifically to explore certain values and value conflicts in the home (Hutchinson et al., 2003).

The Politics of Value-Sensitive Design

Value-Sensitive Design contributes fairly straightforward tools for designers and others in human-computer interaction to use, with a focus on actually impacting design rather than simply critiquing it. However, it makes no pretense of political neutrality. Here, I will highlight three weaknesses in VSD and their political implications: its understanding of design, its understanding of users, and its transparency around the choice of values to study.

Despite its centrality to HCI and the fact that "design" is in its name, VSD is theoretically weak in discussing how values actually influence the design process itself. It advocates iterative design, common in HCI generally, it provides values and feedback from users as input to design, and it gives examples of designs done in the VSD style,[2] but it does not provide a systematic method for making sure values inform design: the design process itself is left to the whims of the designer. In this way, VSD falls prey to what Daniel Fallman calls the "romantic account" of the designer, whose creative genius cannot be analyzed or channeled to follow methodical steps (Fallman, 2003). As a consequence, the translation from value to design could be more a matter of framing – either to stakeholders or to an academic audience – than of any actual influence in the design process. Moreover, the many potentially political choices which go into generating a particular design, whether related to the values of interest or not, are left unexamined.

[2] The closest that the values-focused literature reviewed here comes to informing design is the very thorough case study description, with suggestions, that Flanagan *et al.* have conducted ().

VSD is also relatively underdeveloped in analyzing how users understand and integrate technologies into their practices, especially compared to approaches from science and technology studies which I will review below. Though VSD does include multiple iterations and evaluations of a technology, each provides only a static snapshot of use without specifically accounting for stakeholders' dynamic process of interpretation or interactions, or other changes in stakeholder groups over time. This impoverished view of users could contribute to legitimizing the colonialist tendencies of VSD that I will discuss next.

Finally, in its focus on values of "moral import," Value-Sensitive Design takes a normative – and one may say quite political – approach to identifying and influencing the politics in technologies. In VSD, it is generally the prerogative of the researcher to decide which values to focus on and how to build them into the system. This uncritical, unsituated approach to research could be problematic, even with the best intentions. In particular, researchers run the risk of practicing a kind of cultural imperialism in enforcing their own politics and perspectives (e.g. white, middle-class, liberal, American) on groups who may not share the same values. Though VSD waves away such critiques by pointing to evidence of universal values, anthropologists and other scholars have contributed a substantial and theoretically-rich body of literature to the problems of these kinds of approaches (e.g. Mohanty, 1988; Said, 1989).

The normative and often *a priori* approach to identifying values in VSD has been critiqued by others in the human-computer interaction community. In particular, Le Dantec *et al.* suggest an inversion of the conceptual and empirical phases of investigation to prioritize the values of the community over the "moral values" that the researchers

have (pre-)identified as important (Le Dantec, Poole, & Wyche, 2009). They also promote the use of photo-elicitation interviews to further reduce the power of the researcher relative to the interview participants. In one study involving use of mobile phones by homeless people, participants were instructed to take photographs relevant to their experiences and the context of technology use, which were then used to direct the course of the interview. In another study of RFID perceptions, participants were presented with pre-selected images and asked to reflect on what RFID had to do with the image and why. Le Dantec *et al.* found that this approach uncovered many unexpected values and immersed the researchers more fully in the world of the participants than the traditional VSD approach.

Of course, there are also political implications of prioritizing the values of the community over any normative judgments. One may argue that this approach simply recreates the status quo and preserves existing power imbalances between stakeholders. And like VSD, it assumes a fairly passive user and static interpretations of a particular technical prototype, and black-boxes the design process itself. Le Dantec *et al.*'s approach is closer to the kind of judgment-reservation found in ethnomethodology, a technique from sociology (e.g. see Attewell, 1974 or Garfinkel, 1996) that has become popular in human-computer interaction for exploring the context of technology use and the understandings and categories of users (Dourish & Button, 1998). Ethnomethodology, as its name suggests, focuses on the "methods" or everyday social actions of people and they way people make sense of and categorize those methods (and are held accountable by one another to those categorizations). It often exhibits normative agnosticism,

particularly when applied in HCI, where participants' categories are simply accepted rather than critiqued.

One may speculate that ethnomethodology is as popular in HCI as it is, and Le Dantec's critique of VSD seems as natural as it does, because HCI in general tends to be politically agnostic. HCI tends to have an "administrative point of view" and "marketing orientation" that is heavily reliant on industry support and afraid of being too critical, much like early communication studies did in the 1940s and 1950s (Gitlin, 1978). However, there are indications that this is changing, in part due to some of the research I will review here.

In this environment, then, the development of Value-Sensitive Design is particularly remarkable. However, there are alternative approaches in HCI, often borrowing from other disciplines in the humanities or social sciences, which allow a critical voice but have different political implications. For instance, scholars such as Lucy Suchman and Phoebe Sengers have been importing theories and methodologies from anthropology, science and technology studies, and other fields in the humanities and social sciences that have better-established critical perspectives (e.g. see Suchman, 1987 which is particularly well-referenced in HCI; Suchman, 1994 for a critique of the Language-Action approach to understanding humans and machines; and Sengers, 2005 for a philosophical account of the role of HCI in structuring everyday life). More recently, there have been calls to establish subfields of "feminist HCI" (Bardzell, 2010) and "Postcolonial Computing" (Irani, Vertesi, Dourish, Philip, & Grinter, 2010) in HCI, bringing postmodern, situated, critical perspectives on technology to human-computer interaction. Thus, while Value-Sensitive Design and the "values" perspective more

generally have been popular in human-computer interaction, there are alternative approaches even within HCI that address some of its shortcomings.

Politics in the Social Construction of Technology

The Value-Sensitive Design framework shares some features with the Social Construction of Technology (SCOT) framework, developed in the field of Science and Technology Studies. In particular, SCOT identifies the different, and at times competing, groups that interact with a technology as "relevant social groups," similar to VSD's stakeholders (Pinch & Bijker, 1992). As in VSD, relevant social groups are defined by their common interpretations of – and problems with – a new technology. Also like VSD, SCOT assumes that designers shape the form and function of the technology over time in response to the use patterns and demands of these relevant social groups, responding much like the supply side of an idealized free market.

SCOT departs from VSD in how it theorizes *use*. In contrast to VSD's relatively passive users and static interpretations, in SCOT, new technologies are characterized by a dynamic process of *interpretive flexibility* until they are integrated into stable practices by the relevant social groups. Through interpretive flexibility, technologies may be both psychologically and physically reinvented by different relevant social groups. They initially fit uses of new technologies into their existing practices, and then gradually shift their practices to account for new features or constraints of the technology according to the *technological frame* they construct to understand the technology.

Like Kuhn's paradigms, technological frames structure the interactions between members of a relevant social group and a technology, shaping the way they think about it and use it. Philip Brey eloquently describes technological frames as

> … a repository of knowledge, cultural values, goals, practices, and exemplary artifacts shared by a social group, which structures their attributions of meaning to object and processes in technical innovation, and their subsequent actions. (Brey, 1997, p. 6)

In this way, Bijker explains, a technological frame both describes the actions and interactions of actors, showing how they socially construct a technology, and explains the influence of the technical on the social, since a technological frame is built up around a specific artifact (Bijker, 1989).

Over time, the technological frame, uses, and design for a particular technology stabilize, interpretive flexibility collapses, and the technology reaches *closure* for that relevant social group. When multiple relevant social groups perceive that their problems with the design of a technology have been resolved, the technology is said to have *stabilized*. The result may be hybrid solutions to satisfy tensions between relevant social groups, or multiple separate solutions if the conflicts between relevant social groups could not be resolved. A technology's interpretive flexibility may re-open even after stabilization if new relevant social groups are introduced (Bijker, Hughes, & Pinch, 1989).

In order to research this process of interpretation and stabilization, SCOT includes two methodological stages. In the first stage, one reconstructs the various alternative interpretations of a technology, the technological frames that shape these interpretations, and the conflicts between these alternatives, and then connects them to specific design features of the technological artifact (Bijker, Hughes, & Pinch, 1989). For instance, in his study of the development of the bicycle, Bijker found that there were two relevant social groups at odds with one another: what could be called the "commuters" on one hand, those who wanted to use the bicycle to safely and efficiently move from place to place,

for whom early chain bicycles were produced; and the daredevils on the other hand, what they refer to as "young men of means and nerve" who wanted the bicycle for racing, and for whom the penny farthing, fast but easy to flip, was optimized (Bijker, 1995a).

Then, the second stage of SCOT research shows how closure within groups, and then stabilization between groups, is reached (Bijker, Hughes, & Pinch, 1989). In Bijker's bicycle example, consensus between these two competing relevant social groups was triggered by a technical innovation: the improvement of air tires and chain mechanisms to make bicycles with two equal-sized wheels, by far the safest of the available designs, faster than penny farthings in races. When this happened, the goals of both of these groups were no longer competing, and the design of the bicycle stabilized on a form that is quite familiar to us today (Bijker, 1995a). (Of course, decades later it would be reopened by a new relevant social group of bicycle enthusiasts who wanted to rugged bicycles to ride off-road and were in tension with efficiency-conscious road cyclists, but that is another exploration.)

SCOT's Hidden Politics

In the previous section, I explained the basics of the SCOT theoretical and methodological framework. What about the politics in the machine? In SCOT, technologies aren't explicitly political at all – as in Value-Sensitive Design, they are relatively passive. Technologies may encourage certain technological frames over others and they may allow for more or less interpretive flexibility, but even those "actions" are understood as social constructions, the results of social choices on the part of designers. Then, the relevant social groups do the work of interpreting the technology in relation to their practices and technological frames, allowing technology to remain passive.

In contrast to Value-Sensitive Design's focus on choosing values to design *into* technologies, the Social Construction of Technology theorizes the ways that "values" and other features are understood by users. In this way, SCOT is analytical rather than proactive, and in fact is often employed in historical analyses of technological adoption long after stabilization. One may also argue that this biases SCOT analyses toward successful technologies that *did* stabilize, rather than technologies that failed altogether. Like VSD, SCOT lacks a theoretical framework for, or much discussion of, the design process itself. But unlike VSD, it doesn't actively seek to change the design of technology, so this omission could be argued to be one of scope.

Moreover, with its facile assumption that designers will (eventually) shape technologies to fit users' expectations, SCOT neatly sidesteps questions of power differences between designer and relevant social groups, between multiple relevant social groups, within a particular relevant social group, or between relevant social groups and what could be called "*ir*relevant social groups," the "indirect stakeholders" of VSD who are marginalized in use or affected without agency. Its capitalist approach – "if there's a market, there will be a design for it" – ignores institutionalized inequalities of power that circumvent "ideal" market conditions such as race (e.g. see Nakamura, 2002), class, gender (e.g. see Berg & Lie, 1995 and Wajcman, 2009), and others. While SCOT does not require that all relevant social groups have equal power, it doesn't generally specify otherwise, either.[3] And its case studies, with their focus on the relevant social groups who *did* have a say in the final design of a technology, make it easy to assume that all groups were represented and had an equal say.

[3] Bijker did later respond to this criticism by noting that actors are not always in control of the technological frames they are in (Bijker, 1995b, p. 282), but this modification seems to be absent from most analyses using the SCOT framework.

While VSD is specifically normative, SCOT generally avoids making evaluative statements of different technologies or relevant social groups. This equalizes the researcher and participants more than VSD does, but it also appears to make the theory politically agnostic or even politically conservative, since silence often suggests assent, as Winner has pointed out (Winner, 1993). SCOT also does not explicitly situate the researcher in the frame of research, contributing to a sense that the researcher is outside of the technological frames s/he is studying, omniscient and objective. It also assumes an unproblematic categorization of relevant social groups and the features of a technology that they find most important, further lending power to the researcher.

However, in *The Social Construction of What?*, Ian Hacking points out that the social constructivist approach itself, through deconstructing technosocial relations that we may take for granted, naturally suggests that things could be otherwise (Hacking, 1999, p. 6). Bijker has also expressed hope that SCOT could be a democratizing force by showing that it is possible to influence the course of technological adoption (Bijker, 1995a). Unfortunately, Brey notes that empirical evidence is against SCOT in this regard: SCOT has instead been used by those in power to further reinforce their positions (Brey, 1997, p. 10). Similarly, Oudshoorn *et al.* have found that designers tend to design technologies with people like themselves in mind (Oudshoorn, Rommes, & Stienstra, 2004); in this way, studying those who appeared to have input into the design of a technology just reinforces the power of the designer.

Thus, SCOT may not be normative, but Winner points out that it does have "social constructions" of its own (Winner, 1993), such as assuming that consensus and closure will eventually be reached. With a focus on the actions of relevant social groups,

a view of technology as passive, and a goal of finding stabilization, SCOT tends to ignore the deeper political, economic, or sociocultural foundations of social choices and technological frames and the larger social consequences of technology (Winner, 1993; Brey, 1997). Next, we turn to an exploration of Actor-Network Theory which shares intellectual roots with SCOT, but has a markedly different approach to theorizing technology, with significant consequences.

Actor-Network Theory: The Politics of Humans and Nonhumans

Actor-Network Theory, like Social Construction of Technology, is fundamentally constructivist, trying to account for some of the same problems with essentialist or technologically deterministic arguments in the popular press and the philosophy of technology in the 1970s and before (Brey, 1997). However, ANT departs from SCOT in its approach to the agency of technology. ANT's primary contribution is in treating humans, technology, knowledge, institutions, and infrastructure all as simply *actors* working with, or against, one another to produce various networks. Bruno Latour argues that this approach allows us to reduce both social and technological determinism to "absurdities," since it renders arguments about what is "social" and what is "technical" moot by erasing the line between the two:

> We deal with characters … some human, others nonhuman; some competent, others incompetent. You want to cut through this rich diversity of delegates and artificially create two heaps of refuse: 'society' on one side and 'technology' on the other? (Latour, 1988, p. 308)

To begin my description of ANT, I will start with Latour's account of the *delegation* of actions and competencies between actors of all sorts, both human and nonhuman. Latour examines the action of closing a door to illustrate delegation. People who pass through a door may not be disciplined to close the door behind them, but this

action can be delegated to somebody or something else. It could be delegated to another human, but this tedious job is much more efficiently done when delegated to a machine. The machine, in turn, may delegate actions back to humans such as passing through the door with an outstretched hand to avoid a sprung door swinging back at full force, pushing harder to give a hydraulic door-closer the energy it needs to close softly, or even attempting to revert to door-closing ourselves when "the groom is on strike" and is not functioning (Latour, 1988, p. 302).

Latour posits that all actors are *inscribed* with social scripts or scenarios, which are *described* or retrieved in action. For instance, various kinds of door-closers are all inscribed with the basic script of closing the door behind those who pass through, but they have additional layers inscribed over this: a strong spring slams the door rudely, while a hydraulic piston closes the door gently but petulantly resists opening. Moreover, actors *prescribe* certain functionality in *other* actors, to which those actors in turn may *subscribe* if they fulfill their expected roles or *des-inscribe* if they do not. For example, drivers may prescribe the traffic light with a particular sequence of red, green, and yellow lights (and in return the light prescribes drivers who know and follow its rules), or a computer may prescribe an attentive and patient user (to which many des-inscribe). In addition, actors may have pre-inscribed knowledge or properties – such as the learned ability drive a car or type, or the physical properties of a spring or piston – that they bring to a particular interaction.

While Latour argues that humans and nonhumans are analytically equivalent, he does make the point that nonhuman actors differ from their human counterparts in several important ways. First, he argues that machine actors are "relentlessly moral" in their

actions: a mechanical door-closer will patiently wait for hours or days for somebody to push open the door, while a human doing the same task would very quickly get bored (p. 301). Second and more important, machines are lieutenants for their human designers, who have *shifted out* their technologies to the messy, unpredictable world (p. 309).[4] In this way, while the technologies are the agents that directly interact with humans, the designers are the ones who are (at least partially) responsible for the nature of the interaction. For instance, it is the nature of hydraulic pistons to make doors difficult to push, thus discriminating against feeble door-openers (p. 302). However, the general domain of all door-closers is likely more flexible, and therefore the designers could have conceivably chosen something other than a hydraulic piston to close the door and eliminated the inbuilt discrimination.

John Law suggests that subjecting humans and nonhumans, and also weak and powerful, to the same analysis can act as an equalizer, avoiding an artificial focus on some actors in the network at the expense of others (Law, 1992). Moreover, one can also analyze *knowledge* as part of these networks, since knowledge, and its circulation, "always takes material forms" (p. 2): it is always embodied in some actor, and it acts to keep networks composed of these "heterogeneous" actors in a particular order. In fact, all of the various actors in a network act on one another to maintain, or at times resist, order (and, in fact, they continuously generate the roles and identities of one another). While many actors, when acting as expected, can mask the networks that produce them, it is the job of the social scientist (even though s/he is but another network actor) to uncover these

[4] Latour describes "shifting out" as the "displacement of a character either to another space or to another time or to another character." For instance, in storytelling authors and readers may be "shifted out" from their actual settings to the setting of the story. In this context, "shifting out" means the change from the designer's studio and the designer's *imagined* scenarios of use to actual use.

networks, which also allows an exploration of the sources, pathways, and production of power (pp. 5-6).

Michel Callon, another foundational theorist of Actor-Network Theory (ANT), further theorizes actors' work in negotiating, establishing, and masking the networks in which they act, which he terms *translation* (Callon, 1986).[5] He also contributes three methodological imperatives for using ANT: first, one should strive to be agnostic, not favoring some actors/networks or censoring others; second, one should describe all actors/networks using the same framework and vocabulary; and third, one should treat technical and social actors the same (echoing Latour and Law) and analyze actors' categories rather than imposing one's own. The methodology that lends itself most naturally to this approach is the qualitative case study, where a case is defined around the technical artifact under investigation; indeed, it appears to be the methodology of choice among the ANT researchers reviewed here.

Actor-Network Theory has been taken up by a number of other scholars in the Science and Technology Studies area. Madeleine Akrich, also borrowing some tools from SCOT, focuses on the semiotic mismatches and negotiations between groups of actors – particularly users and designers – concerning the boundaries and use of technical artifacts as a way to deconstruct the *scripts* designers built into the artifact and the *de-scription* that users do in understanding and using it. This also allows an exploration of the unintended consequences of the technology and some of the larger social consequences of the artifact. As Akrich says,

> If most of the choices made by designers take the form of decision about what should be delegated to whom or what, this means that technical

[5] In fact, Callon prefers to call Actor-Network Theory the "sociology of translation" to highlight the importance of this activity.

> objects contain and produce a specific geography of responsibilities, or more generally, of causes. (Akrich, 1992, p. 207)

To uncover the "geography of responsibilities" that technologies produce, Akrich looks at technologies designed for one group and then transported to a group that differs markedly from the first, which happens particularly frequently in economic development projects. In one case, a photovoltaic light designed by the French government was meant be tamper-proof to avoid injury or damage to the system, but when sent to "Africa"[6] turned out to be unusable: the hotter weather killed the batteries much sooner than expected, the switch was overhead on the light rather than accessible, all of the connectors were custom and sealed, and the system used high-voltage direct current and couldn't be serviced by local electricians (p. 211). Here, the boundaries of the object for the French designers stopped at the object's physical perimeter, and they designed to enforce this boundary. However, the users required a boundary that allowed an understanding of the object's parts and functions. In this case, this tension resulted in design failure.

Actor-Networks, Politics, and Power

Of the frameworks surveyed so far, ANT most explicitly describes (or perhaps *prescribes*) the role of the researcher. In VSD, the researcher was an all-knowing and impartial enforcer; in SCOT, s/he was an omniscient but invisible watcher. While ANT does not situate the researcher in the way that feminist theorists like Donna Haraway advocate (Haraway, 1988), it does explicitly recognize the researcher's tendencies to prioritize certain actors and networks over others and cautions the researcher against these tendencies. ANT also uses qualitative empirical case-studies to develop theory, which sociologist Michael Burawoy advocates as a reflexive alternative to the positivist

[6] Here is another semiotic black-boxing, but outside of the scope of this particular critique.

goals of replicability and generalizability typical in quantitative research (Burawoy, 1998). However, ANT makes no specific claims to reflexivity: as in VSD and SCOT, the position of the researcher in ANT is not examined.

Actor-Network Theory is the first of the frameworks surveyed to give agency to the technology under study. This complicates our questions of how values are built into designs and how these designs engage users with the value systems of their makers – in short, how artifacts have politics. To Winner's 1986 essay "Do Artifacts have Politics?" John Law responds,

> Artefacts may, indeed, have politics. But the character of those politics, how determinate they are, and whether it is possible to tease people and machines apart in the first instance – these are all contingent questions. (Law, 1992, p. 3)

What do we gain with this, particularly regarding the politics in technologies? Philip Brey points out that this allows technologies to "have consequences that are neither intended nor anticipated by any social group" (Brey, 1997). For example, the infamous Therac-25 machine was not *designed* to give doses of cancer radiation treatment hundreds of thousands of times stronger than recommended; though it was missing the safeguards and sound software engineering that it should have had to prevent this, a complex combination of design and use brought out this behavior in rare cases (Nissenbaum, 1996). Similarly, the automatic pilot feature on airplanes was meant to relieve human pilots of the strains (at times tedium, at times information overload) of piloting increasingly complicated aircraft, but these machine pilots also *de-skill* their human counterparts such that in emergencies, they may both be at a loss about what to do (Charette, 2009). Decoupling technology from a purely social process of design and use

and giving it agency thus allows more freedom for technologies to develop politics of their own.

One critique of this approach is that *agency* is not the same as *intentionality.* Giving agency to nonhumans can at once promote them to autonomous beings and demote humans to machines without thoughts and intentions. Reminiscent of 1950s behaviorism, this in effect black-boxes actors themselves. In fact, some critique Actor-Network Theory as not including a theory of the actor, except to say that actors are defined through inscriptions/descriptions/prescriptions and likewise define other actors in the same way (1999). However, Michel Callon has argued that this weakness is actually a strength:

> ANT is based on no stable theory of the actor; rather, it assumes the *radical indeterminacy* of the actor. For example, the actor's size, its psychological make-up, and the motivations behind its actions – none of those are predetermined. … Since everything is action, the ANT actor may, alternately and indiscriminately, be a power which enrolls and dominates or, by contrast, an agent with no initiative which allows itself to be enrolled. (Callon, 1999, p. 181-182)

In addition to giving technologies agency, Actor-Network Theory also theorizes the "scripts" that designers *do* actively design into technologies. Though the power of the designer was largely invisible in VSD and SCOT, these scripts provide a theoretical window on the design process in ANT, allowing researchers to investigate the process of *inscription.* Then, researchers can identify political consequences such as the marginalization of certain groups or the intent to control action in certain ways, as Akrich did in her investigation of solar lighting units described above (Akrich, 1992). Thus, while not all ANT researchers do so, Philip Brey points out that one *can* "take a normative or political stance by analyzing the way in which particular technologies ... come to embody a particular politics or particular social effects" (Brey, 1997, p. 8).

However, in practice ANT at times suffers from the same lack of normative position that SCOT does, and the same critiques of social conservatism can be applied in these cases (Winner, 1993).

There is a tension here in the breakage of symmetry between designers and other actors. While Actor-Network Theory purports to treat all actors the same, designers are given this extra power of inscription, with which they can affect the world remotely. On the other hand, like SCOT, Actor-Network Theory makes it easy to believe that actors other than designers have equal agency in producing their networks and social worlds. ANT, in fact, specifically instructs the researcher to analytically treat all actors equally, obliging the researcher to bring in other theories or methodologies to distinguish between the more powerful and less powerful actors. After all, some actors may not have the faculties to establish, negotiate, or mask the networks in which they are involved, and they may in fact be enrolled in – or marginalized from – networks against their will. While John Law and other ANT theorists recognize that not all actors have equal agency (Law, 1992), ANT does not provide analytical tools to account for it in analysis, making it easy to overlook.

ANT does, however, take an explicit stance toward power, in contrast to VSD and SCOT (Law, 1992). In its approach, ANT echoes Foucault's discursive approach to culture and power, where there is a constant flow and rebuilding of meaning, material, and culture. There is no agency except in these structures, which are constantly being produced and reproduced by each other, just as actors define and are defined by other actors in the networks of which they are a part. To those who have used this framework, the discursive struggle to structure these cultural meanings and signs becomes the

struggle for power (e.g. see Edwards, 1996). Similarly but even closer to ANT's self-reproducing networks of actors, Bartky's diffuse form of self-discipline is not enforced or even taught by a central governing body, but adopted and reproduced willingly (Bartky, 1988). Clegg and Wilson point out that both of these approaches use a Machiavellian metaphor for power, where actors all scheme for political advantage in a distinctly pre-modern Florence, in contrast to the modern, zero-sum, Marxist approach to power (Clegg and Wilson, 1991).

More generally, in focusing in on the scripts and actions of actors, ANT, like SCOT, makes it easy to overlook the deeper political, economic, or sociocultural foundations of its networks or their broader social consequences. ANT seems to be generally more interested in exploring *how* actor-networks form, perpetuate, or disintegrate than *why* they do so, and it tends not to account for pre-existing power structures (what would this mean, in a world of actor-networks that perpetually work to create and re-create themselves?).

A number of the scholars responsible for establishing Actor-Network Theory have acknowledged many of the critiques that have been leveled against ANT since its inception in a book-length discussion of "what comes after" ANT (1999). Bruno Latour provides his answer to a debate between the various contributors about whether they want to move on from Actor-Network Theory to other approaches to understanding technology, where he states that he couldn't abandon their creation, even in light of its flaws, so easily: in his opinion, they can, and should, adapt.

> The only solution is to do what Victor Frankenstein did *not* do, that is, not to abandon the creature to its fate but continue all the way in developing its strange potential. (Latour, 1999, p. 24)

Conclusion: Politics in Artifacts, Artifacts in Politics

Now that we have explored Value-Sensitive Design, the Social Construction of Technology, and Actor-Network Theory, let us return to the seminal work of Langdon Winner, discussed briefly in the introduction of this article and referenced, in turn, by scholars in each of the disciplines discussed above. Compared to these three frameworks, Winner contributes an unequivocal account of politics in technology. But in light of our critical assessment of these three frameworks, we can also see where Winner's argument itself has "politics."

First, like Value-Sensitive Design, Winner is sensitized to the values built into machines, and of the three frameworks surveyed here, VSD's specifically normative agenda most closely matches Winner's broader political stance. But like VSD, Winner does not grant the user much agency in interpreting these values: in discussing how politics are embedded in machines, he presumes a degree of inevitability in how various stakeholders are affected by them.

Second, similar to the ways that technological frames can structure thoughts about and interactions with an artifact in Social Construction of Technology, Winner recognizes that artifacts can both embody and symbolize power. In this way, social worlds can reproduce themselves through machines: Winner's nuclear reactor reorients action around it with its political characteristics, which require hierarchical military support and protection. As in SCOT, most of Winner's artifacts are relatively passive – they have politics embedded *into* them – and the divide between the material and the social is maintained. However, SCOT would have difficulty in explaining the technologies that are *inherently* political, such as the nuclear reactor.

Finally, Winner's politics accord well with the "scripts" that designers embed in other actors in Actor-Network Theory. And though Winner does maintain a difference between "humans and nonhumans," the artifacts that Winner analyzed can also have unintentional effects. For example, some of the unintentional (as far as we know) effects of the mechanical tomato-harvester that Winner examined included the loss of jobs for migrant farm-workers, the disadvantaging of small farms, and the triumph of hardier but less ripe and flavorful tomato varieties over more delicate ones that were too damaged by the harvester. It is only when the harvester interacts with other actors that such consequences play out.

Others have critiqued Winner for having a political agenda of his own (e.g. see Joreges, 1999; Woolgar & Cooper, 1999). Indeed, each of these frameworks has an agenda as well, whether to design more value-conscious technologies or just to problematize the values that have been built in already. Haraway and other feminist scholars would argue that we cannot escape having *some* agenda: after all, the researcher is also situated in the social world s/he studies. Thus, this essay provides an analysis to assist in choosing, with eyes open, an approach to evaluating technology that accords with the politics the researcher wants to support.

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