

Feminist theories of technology

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Feminist theories of technology have come a long way over the last quarter of a century. The expanding engagement at the intersection of feminist scholarship and science and technology studies (STS) has enriched both fields immeasurably, and I will largely focus my reflections on the literature associated with these sites. I begin by highlighting the continuities as well as the differences between contemporary and earlier feminist debates on technology. Current approaches focus on the mutual shaping of gender and technology, in which technology is conceptualised as both a source and consequence of gender relations. In avoiding both technological determinism and gender essentialism, such theories emphasise that the gender-technology relationship is fluid and situated. These deliberations highlight how processes of technical change can influence gender power relations. A feminist politics of technology is thus key to achieving gender equality.

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1. Introduction

This article provides an overview of the various approaches to conceptualising the link between gender and technology, both past and present. In turning to this task, I should emphasise that feminist discussions have always taken diverse and overlapping forms. While standard accounts of feminist thought tend to present liberal, socialist and post-modern feminisms as distinct perspectives, in reality they did not develop as independent strands or in a simple chronological order. Moreover, like the field of science and technology studies (STS), feminist scholarship works across disciplines and is organised around core interests and problems resulting in a heterodox body of work. For our purposes here, I will, of necessity, present the different strands rather schematically in order to highlight their contrasting perspectives. However, what should emerge from this overview is an understanding of their interconnectedness, and the shared concern between earlier and more recent ‘technofeminist’ theories to interrogate the gender power relations of the material world (Wajcman, 2004).

I will begin by looking at how a feminist perspective shifts our understanding of what technology is, broadening the concept to include not only artefacts but also the cultures and practices associated with technologies. I then outline some early approaches that

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emphasised the role of technology in reproducing patriarchy, contrasting this with more recent cyberfeminist writings that see digital and biomedical technologies as offering possibilities for destabilising conventional gender differences. The essay will then examine the exciting body of work that has burgeoned at the intersection of feminist scholarship and STS over the past few decades. Such approaches focus on the mutual shaping of gender and technology, where there is no presumption that either gender or technology are pre-existing or that the relationship between them immutable. The resulting literature is generally more critical of technoscience than its forerunners while at the same time being aware of its potential to open up new gender dynamics.

2. Technology as culture

What role does technology play in embedding gender power relations? Let us begin with the traditional conception of what technology is taken to be. On this view technology tends to be thought of in terms of industrial machinery and military weapons, the tools of work and war, overlooking other technologies that affect most aspects of everyday life. The very definition of technology, in other words, is cast in terms of male activities.

An initial challenge for feminists was to demonstrate that the enduring identification between technology and manliness is not inherent in biological sex difference. Feminist scholars have demonstrated how the binary oppositions in Western culture, between culture and nature, reason and emotion, hard and soft, have privileged masculinity over femininity (Harding, 1986). The taken-for-granted association of men and machines is the result of the historical and cultural construction of gender. Similarly, the standard conceptions of innovation, production and work have been the subject of scrutiny. Just as feminist economists have redefined the discipline of economics to take account of unpaid domestic and caring work (Folbre, 2001; Himmelweit, 2003), so too feminist scholars of STS have argued for the significance of everyday life technologies (Cowan, 1976; Stanley, 1995). A revaluing of cooking, childcare and communication technologies immediately disrupts the cultural stereotype of women as technically incompetent or invisible in technical spheres.

It is salutary to be reminded that it was only with the formation of engineering as a white, male middle-class profession that 'male machines rather than female fabrics' became the markers of technology (Oldenziel, 1999). During the late nineteenth century, mechanical and civil engineering increasingly came to define what technology is, diminishing the significance of both artefacts and forms of knowledge associated with women. This was the result of the rise of engineers as an elite with exclusive rights to technical expertise. Crucially, it involved the creation of a male professional identity, based on educational qualifications and the promise of managerial positions, sharply distinguished from shop-floor engineering and blue-collar workers. It also involved an ideal of manliness, characterised by the cultivation of bodily prowess and individual achievement. At the same time, femininity was being reinterpreted as incompatible with technological pursuits. It was during and through this process that the term 'technology' took on its modern meaning. The legacy is our taken-for-granted association of technology with men.

In common with mainstream STS, feminist writing has long identified the ways in which socio-technical relations are manifest not only in physical objects and institutions but also in symbols, language and identities (McNeil, 2007). Scientific facts and technological artefacts are treated as simultaneously semiotic and material. Such a broad notion of science and technology (technoscience) as a culture or 'material-semiotic practice' enables

us to understand how our relationship to technology is integral to the constitution of subjectivity for both sexes (Haraway, 1997). To continue with the example of engineering for a moment, here we see a classic case of an archetypal masculine culture, where mastery over technology is a source of both pleasure and power for the predominantly male profession (Faulkner and Lohan, 2004; Hacker, 1989). Such images resonate with the world of computer hackers at MIT described by Sherry Turkle (1984, p. 216): ‘though hackers would deny that theirs is a macho culture, the preoccupation with winning and of subjecting oneself to increasingly violent tests make their world peculiarly male in spirit, peculiarly unfriendly to women’.

This is not to say that all women reject ‘geek culture’, nor that computer science is universally coded as masculine. In Malaysia, for example, women are well represented among computer science students (Lagesen, 2008). Sexual ideologies are remarkably diverse and fluid, and for some men technical expertise may be as much about their lack of power as the realisation of it. However, in contemporary Western society, the hegemonic form of masculinity is still strongly associated with technical prowess and power (Wajcman, 1991). Different childhood exposure to technology, the prevalence of different role models, different forms of schooling, and the extreme gender segregation of the job market all lead to what Cockburn (1983, p. 203) describes as ‘the construction of men as strong, manually able and technologically endowed, and women as physically and technically incompetent’. Entering technical domains therefore requires women to sacrifice major aspects of their feminine identity.

Notwithstanding the recurring rhetoric about women’s opportunities in the new knowledge economy, men continue to dominate technical work. Women’s employment in the information technology, electronics and communications (ITEC) sector is much lower than their participation in the workforce generally, and it is declining in most industrialised countries. In the UK, for example, fewer than one in five ITEC professionals and managers are female and this figure is even lower in IT strategy and software development roles (Evans *et al.*, 2007). This is consistent with the findings of the 2006 Skills Survey which found that men are more likely than women to be found in jobs that involve complex and advanced computer or computerised equipment use and ‘this gender imbalance has changed little between 1997 and 2006 (Felstead *et al.*, 2007, p. xii).¹ These sexual divisions in the labour market are proving intransigent and mean that women are largely excluded from the processes of technical design that shape the world we live in—a point to which I return below.

Labour market economists tend to explain such sex segregation in terms of differences in human capital, domestic responsibilities that fall disproportionately on women, and employment discrimination (Becker, 1991). In this framework, remedying the ‘gender deficit’ is seen as a problem that can be overcome by a combination of different socialisation processes and equal opportunity policies. The strengths and limitations of equal employment opportunity policies have been much debated in recent decades (Bacchi, 1996; Herman and Webster, 2007; Wyatt *et al.*, 2000). Feminists have pointed out that the problem does not lie with women (their socialisation, their aspirations and values) and that we need to address the broader questions of whether and in what way technoscience and its institutions can be reshaped to accommodate women. Such critiques

¹ This is also reflected in the gender pay gap in London, the highest in Britain as a result of the dominance of the finance sector that targets graduates in mathematics, science and engineering (Greater London Authority, *Closing the Gap*, 2008)

emphasise that, in addition to gender structures and stereotyping, engrained cultures of masculinity are still ubiquitous within these industries, causing many young women to reject careers and older women to leave the field. This is fundamentally because women are being asked to exchange major aspects of their gender identity for a masculine version, whilst there is no similar 'degendering' process prescribed for men.

3. Technology as gendered

Recognising the complexity of the relationship between women and technology, by the 1980s feminists were exploring the gendered character of technology itself. In Sandra Harding's (1986, p. 29) words, feminist criticisms of science evolved from asking the 'woman question' in science to asking the more radical 'science question' in feminism. Rather than asking how women can be more equitably treated within and by science, the question became how a science apparently so deeply involved in distinctively masculine projects can possibly be used for emancipatory ends. Similarly, feminist analyses of technology were shifting from women's access to technology to examining the very processes by which technology is developed and used, as well as those by which gender is constituted. Both socialist and radical feminisms began to analyse the gendered nature of technical expertise, and put the spotlight on artefacts themselves. The social factors that shape different technologies came under scrutiny, especially the way technology reflects gender divisions and inequalities. The problem was not only men's monopoly of technology, but also the way gender is embedded in technology itself.

For radical feminism, women and men are fundamentally different and women's power, women's culture and women's pleasure are regarded as having been systematically controlled and dominated by men, operating through patriarchal institutions like medicine and militarism. Western technology, like science, is deeply implicated in this masculine project of the domination and control of women and nature. This approach has been particularly influential in relation to the technologies of human biological reproduction (Corea *et al.*, 1985; Spallone and Steinberg, 1987). It is fuelled by the perception that the processes of pregnancy and childbirth are directed and controlled by ever more sophisticated and intrusive technologies. Radical feminists' strong opposition to the development of the new reproductive technologies (such as *in-vitro* fertilisation) during the 1980s reflected fears of patriarchal exploitation of women's bodies. There was a call for new technology based on female rather than male values.

These approaches took the debate about gender and technology beyond the use/abuse model, focusing on the political qualities of technology. Where liberal feminism sees the problem in terms of male control of neutral technologies, radical feminists argued that gender power relations are embedded more deeply within technoscience. This was also a forceful assertion of women's interests and needs as being different from men's and highlighted the way in which women are not always well served by current technologies. However, in representing women as inherently nurturing and pacifist, it tended to reinforce an essentialist view of sex difference. The historical and cultural specificity of our modern understanding of women as being radically other than men was overlooked (Merchant, 1980). Too often the result was a pessimistic portrayal of women as victims of patriarchal technoscience.

While radical feminism focused on women's bodies and sexuality, the core concern of socialist feminism was the relationship between women's work and technology. Like many of my feminist contemporaries, I came to gender and technology studies from having been

immersed in the 1970s' Marxist labour process debates about the technology of production. This literature provided a compelling critique of technological determinism, arguing that, far from being an autonomous force, technology itself is crucially affected by the antagonistic class relations of production. Technological revolution was understood to be a trait of capital accumulation processes. The socialist feminist approach began by revealing that the division of labour was also a sexual hierarchy, and that its gendered nature was not incidental. A crucial historical perspective was brought to bear on the analysis of men's monopoly of technology. Extensive research demonstrated that women's exclusion from technology was as a consequence of the male domination of skilled trades that developed during the Industrial Revolution (Bradley, 1989; Cockburn, 1983; Milkman, 1987).

Socialist feminist frameworks, then, saw masculinity as embedded in the machinery itself, highlighting the role of technology as a key source of male power (Cockburn, 1985; McNeil, 1987; Wajcman, 1991; Webster, 1989). Instead of treating artefacts as neutral or value-free, social relations (including gender relations) are materialised in tools and techniques. Technology was seen as socially shaped, but shaped by men to the exclusion of women. While this literature did reflect an understanding of the historical variability and plurality of the categories of 'women' and 'technology', it was nevertheless pessimistic about the possibilities of redesigning technologies for gender equality. The proclivity of technological developments to entrench gender hierarchies was emphasised rather than the prospects they afford for change. In short, not enough attention was paid to women's agency. And it is precisely this rather negative register that provoked a reaction from a new generation of feminist scholars.

Moreover, by the late 1980s second-wave feminism had transformed itself in response to sustained critiques from black feminism, queer theory, post-modernism and post-colonial theory. A number of writers now refer to 'post-feminism' or third-wave feminism to mark both an epistemological break, and to denote the period after the height of second-wave feminism (Gill, 2007, pp. 250–1). This more recent work marks a shift away from a focus on equality to a focus on debates about differences between women, stressing that gender is connected to other axes of power such as race, colonialism, sexuality, disability and class. Rather than thinking of feminism, we need to think of feminisms as multiple and dynamic, and in the process of ongoing transformation.

4. Contemporary approaches

If feminists of the 1980s were rather pessimistic about the prospects for women offered by the microelectronic revolution, there was a much more enthusiastic response to the dawn of the digital age. Sharing the optimism of cyber-gurus from Manuel Castells (1996) to Nicholas Negroponte (1995), feminist approaches of the 1990s and today are positive about the possibilities of information and communication technologies (ICTs) to empower women and transform gender relations (Green and Adam, 1999; Kemp and Squires, 1998; Kirkup *et al.*, 2000).

A common argument in this literature is that the virtuality of cyberspace and the internet spell the end of the embodied basis for sex difference (Millar, 1998; Plant, 1998). Cyberfeminists, for example Sadie Plant (1998), see digital technologies as blurring of boundaries between humans and machines, and between male and female, enabling their users to choose their disguises and assume alternative identities. Industrial technology may have had a patriarchal character, but digital technologies, based on brain rather than brawn, on networks rather than hierarchy, herald a new relationship between women and

machines. Writers such as Plant are interested in revalorising the feminine, bringing woman's radical alterity, her difference, into being. For them, the internet and cyberspace are seen as feminine media, providing the technological basis for a new form of society that is potentially liberating for women. According to this view, women, rather than men, are uniquely suited to life in the digital age.

The optimism of this post-feminist literature is best summed up by Donna Haraway's (1985, 1997) cyborg metaphor, conveying the idea that technology is fully part of all of us. Because it is an aspect of our identity, an aspect of our embodiment, conceiving of ourselves as cyborgs provides a tool for transforming the gender relations of technoscience. Haraway notes the great power of science and technology to create new meanings and new entities, to make new worlds. She positively revels in the very difficulty of predicting what technology's effects will be and warns against any purist rejection of the 'unnatural', hybrid, entities produced by biotechnology. Genetic engineering, reproductive technology and the advent of virtual reality are all seen as fundamentally challenging traditional notions of gender identity. As such, they mark a transformation in the relationship between women and technology.

Developments in digital technologies do call for some radical rethinking, both of the processes of technological innovation and of their impact on the culture and practices of everyday life. Haraway's ground-breaking work opened up new possibilities for feminist analyses to explore the ways in which women's lives are intimately entwined with technologies. In looking forward to what ICTs and biotechnologies may make possible, Haraway elaborates a new feminist 'imaginary' different from the 'material reality' of the existing technological order. Her writing has been particularly influential among feminist scholars within STS, epitomising the challenge to second-wave feminism's tendency to portray women as victims of technological change.

While Haraway is optimistic about the opportunities for radical political transformations opened up by developments in technoscience, too often her work has been read as an uncritical acceptance of everything digital. Such enthusiasm has tipped some post-modern commentators towards technological determinism—albeit of a celebratory rather than pessimistic bent. There is still a current in feminist literature on cyberculture that regards new digital technologies as a rupture from more established ones and downplays any continuities between them.

Certainly women have been actively engaged in constructing hybrid, transgendered identities through their consumption of new media. Diary writing on web logs, for example, is a popular activity among young women. However, the possibility and the fluidity of gender discourse in the virtual world is constrained by the visceral, lived gender relations of the material world. Even *Second Life* (an online virtual world with over two million registrations), which is widely seen as promoting anti-establishment values, has become a major source of virtual pornography, apparently well suited to those with a taste for sadomasochistic forms of sex (Bardzell and Bardzell, 2006). Such fantasy cyberworlds, then, are not necessarily comfortable cultural environments for women to inhabit. To move forward, we need to understand that technology as such is neither inherently patriarchal nor unambiguously liberating.

5. Technofeminism: combining feminism and STS

Over the last two decades, feminist writing within the field of STS has theorised the relationship between gender and technology as one of mutual shaping. A shared idea in this

tradition is that technological innovation is itself shaped by the social circumstances within which it takes place. Crucially, the notion that technology is simply the product of rational technical imperatives has been dislodged. Objects and artefacts are no longer seen as separate from society, but as part of the social fabric that holds society together; they are never merely technical or social. Rather, the broad social shaping or constructivist approach treats technology as a sociotechnical product—a seamless web or network combining artefacts, people, organisations, cultural meanings and knowledge (Bijker *et al.*, 1987; Hackett *et al.*, 2008; Law and Hassard, 1999; MacKenzie and Wajcman, 1999). It follows that technological change is a contingent and heterogeneous process in which technology and society are mutually constituted.

Within mainstream STS, the ways in which technological objects may shape and be shaped by the operation of gender interests or identities has not been a central focus. Whilst innovations are seen as sociotechnical networks, it has been largely incumbent on feminists to demonstrate that gender relations inform these networks. After all, if ‘technology is society made durable’ (Latour, 1991, p. 103), then gender power relations will influence the process of technological change, which in turn configures gender relations. Women’s systematic absence from the sites of observable conflict over the direction of technological developments is therefore as indicative of the mobilisation of gender interests as is the presence of other actors. Empirical research on everything from the microwave oven (Cockburn and Ormrod, 1993), the telephone (Martin, 1991) and the contraceptive pill (Oudshoorn, 1994) to robotics and software agents (Suchman, 2008) has clearly demonstrated that the marginalisation of women from the technological community has a profound influence on the design, technical content and use of artefacts.

A social constructivist framework now has been widely adopted by feminist STS scholars (Berg, 1996; Faulkner, 2001; Lie, 2003). In common with my own technofeminist theory, it conceives of technology as both a source and consequence of gender relations (Wajcman, 2004). In other words, gender relations can be thought of as materialised in technology, and masculinity and femininity in turn acquire their meaning and character through their enrolment and embeddedness in working machines. Such a mutual shaping approach recognises that the gendering of technology affects the entire life trajectory of an artefact. Indeed, feminist research has been at the forefront of more general moves within STS to deconstruct the designer/user divide, and that between production and consumption, emphasising the connectedness of all phases of technological development (Cowan, 1987). The gendering of technologies can then be understood as not only shaped in design, but also shaped or reconfigured at the multiple points of consumption and use.

Let me again illustrate this by considering an economist’s account of the impact of technologies on domestic labour. Avner Offer (2006) explains why some kinds of household appliances have diffused more rapidly than others by comparing ‘time-saving goods’ (for example, cookers and washing machines) with ‘time-using goods’ (such as radio and television). However, he is puzzled by the finding that there is no direct link between time-saving appliances and the amount of time spent in housework. While he takes account of rising standards and class differences in housework, his model of consumption is not attuned to the gender relations of artefacts. Domestic appliances enter a domain heavily signified in terms of traditional sex roles, and are already imprinted with gendered agendas or ‘genderscripts’ defining their appropriate operators (Cockburn and Ormrod, 1993; Oudshoorn *et al.*, 2004). Indeed, individuals demonstrate their gender identity in part through their daily use of objects. To be feminine is to perform femininity, and the daily doing of housework continues to be pivotal to being a wife and mother.

Moreover, technological innovations often change the nature and meaning of tasks, as well as introducing novel practices. STS scholarship increasingly recognises that the social meanings of technology are contingently stabilised and contestable, that the fate of a technology depends on the social context and cannot simply be read off fixed sets of power arrangements. The 'domestication' framework, in particular, has sensitised researchers to some of the complex processes at work in incorporating technologies into everyday life (Haddon, 2004; Silverstone and Hirsch, 1992). In line with social shaping principles, domestication foregrounds user agency in the way people continuously interpret, appropriate and use artefacts in their everyday lives.

Similarly, the concept of gender itself is now understood as a performance or social achievement, constructed in interaction (Butler, 1990). Rather than conceiving of gender as fixed and existing independently of technology, the notion of performativity, or 'gender as doing', sees the construction of gender identities as shaped together with the technology in the making. Thus, both technology and gender are products of a moving relational process, emerging from collective and individual acts of interpretation. It follows from this that gendered conceptions of users are fluid, and that the same artefact is subject to a variety of interpretations and meanings. The result is more nuanced feminist research that captures the increasingly complex intertwining of gender and technoscience as an ongoing process of mutual shaping over time and across multiple sites.

6. Conclusion

Feminist theories of technology have come a long way over the last quarter of a century. The intellectual exploration at the intersections of feminist scholarship and STS has enriched both fields immeasurably. While each has been characterised by diverse lines of argument over the last decades, the underlying continuities are all the more striking. Both fields foreground the way that people and artefacts co-evolve, reminding us that 'things could be otherwise', that technologies are not the inevitable result of the application of scientific and technological knowledge.

For me, the distinguishing insight of feminist STS or technofeminism is that gender is integral to this sociotechnical process: that the materiality of technology affords or inhibits the doing of particular gender power relations. Women's identities, needs and priorities are configured together with digital technologies. For all the diversity of feminist voices, feminist scholars share a concern with the hierarchical divisions marking relations between men and women.

Key to our analysis is the understanding that, while gender is embedded in technoscience, the relationship is not immutably fixed. While the design process is decisive, sociotechnical configurations exhibit different degrees of determination and contingency at different moments in their relationship. The capacity of women users to produce new, advantageous readings of artefacts is dependent on their broader economic and social circumstances.

Such a perspective redefines the problem of the exclusion of groups of people from technological domains and activities. Technofeminism exposes how the concrete practices of design and innovation lead to the absence of specific users, such as women. While it is not always possible to specify in advance the characteristics of artefacts and information systems that would guarantee more inclusiveness, it is imperative that women are involved throughout the processes and practices of technological innovation. STS provides a theory of the constitutive power of tools, techniques and objects to materialise social, political and

economics arrangements. Drawing more women into design—the configuration of artefacts—is not only an equal employment opportunity issue, but is also crucially about how the world we live in is shaped, and for whom. We live in a technological culture, a society that is constituted by science and technology, and so the politics of technology is integral to the renegotiation of gender power relations.

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