From Gender Analysis to Technology Design Methodologies: Implications for Theory

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Abstract

This paper explores the potentials and limitations of the concept of 'gender scripts' for a de-gendering approach to computational artefacts. The de-gendering approach offers alternatives to conventional technology design, which often leads to gender biased artefacts. It is here introduced as a strategy to locate gender studies within the computer science discipline. In proposing methodologies for technology design, which aim to avoid the gendering processes, de-gendering crucially depends on a thorough analysis of how computational artefacts become gendered. It will be shown that the concept of 'gender scripts' provides a powerful tool to understand the gendering of certain information technologies. However, the concept fails to explain the gendering processes in Artificial Intelligence as well as on epistemic and ontological levels, for which I suggest an enhanced theoretical framework in drawing on Suchman's 'Human-Machine Reconfigurations' and Barad's 'Posthumanist Performativity'.

Introduction

'Gender studies in computer science' is a new research field, which was only recently introduced at German universities. While conferences on this subject were held since the late 1980s and the subdivision '*Frauenarbeit und Informatik*' of the German society of computer professionals has been in existence for more than 20 years, professorships for gender studies in computer science departments were established only during the last decade (e.g. 1998 at Bremen University, 2004 at Hamburg University). Several edited books demonstrate the broad corpus of knowledge on gender in computer science that has been generated from these flourishing discussions (cp. Kreutzner & Schelhowe 2003; Oechtering & Winker 1998; Schmitz & Schinzel 2004; Zorn et al. 2007).

The attempts to explore and institutionalize gender studies within the discipline offer the chance to move beyond the 'women into IT!' approaches and also break with the assumption of essential differences between women and men in the use and design of technologies. Initially, the field was often understood as addressing the problem of getting more women into IT professions, which rests on the assumption that technology is (gender) neutral. However, such an account does not question computational theories, paradigms, methods and products. A second common understanding, which focuses on alleged gender differences in the design and use of information technologies, has a tendency towards essentialism and, therefore, does not take into account current discussions in gender studies. In order to overcome both liberal approaches to gender in technology as well as essentialism, there is a need for further studies that focus on the gendered shaping of computational artefacts. Such a research perspective additionally lacks a thorough theoretical foundation.

Feminist science and technology studies seem to be a good starting point on which to base a gender analysis of computational artefacts. In this line of thinking, research on gender and technology has so far been most commonly framed with the theoretical concept of the 'co-construction of gender and technology', which implicitly criticizes both traditional STS and mainstream gender studies. On the one hand, the co-construction approach takes into account that 'technology itself cannot be fully understood without reference to gender' (Cockburn 1992, 32), on the other hand, it acknowledges that 'one cannot understand gender without reference to technology' (Faulkner 2001, 90). Conceptualizing the relationship between gender and technology as a co-construction implies studying 'mutual shaping relationships between gender and technology, in which technology is both a source and consequence of gender relations' (Wajcman 2004, 107).

Nevertheless, STS research based on the co-construction approach largely focuses either on users (e.g. Oudshoorn & Pinch 2003) or on the role of technology in the construction of gender identity (e.g. Kleif & Faulkner 2003; Lohan & Faulkner 2004). Only a few studies present deeper insights into the processes of how computational artefacts become gendered on structural-symbolic, ontological and epistemic levels. When shifting the focus from the analysis of gendering processes to the technological design, it becomes

even harder to find any research addressing these questions. In order to locate gender studies within the computer science discipline, though, it has to be pointed out how gender affects the activities of computer scientists and the development of their products, methods, theories and foundations (e.g. computational artefacts). Since computer science is ultimately an engineering discipline, gender studies must show, furthermore, how gender analysis can be made fruitful for constructing computational artefacts. One way of doing this is the de-gendering approach.

De-gendering of computational artefacts 'in a nutshell'

Several questions need to be clarified before trying to proceed in this direction: What is gender? What does gendering of artefacts mean? And in what way can gender studies contribute to build (better?) technologies? My theoretical framework is built upon a constructionist understanding of gender (and technology). Gender is considered to be fluid, a constantly re-negotiated category, which is not determined by biology, but produced and reproduced within the tension between performance and performativity (Butler 1990; 1993). For the purpose of this paper, I focus on gender as 'gender bias' in the sense that gender stereotypes and assumed differences (be it physical differences, social order, symbolic order, structures of inequality, binary sex system) are 'inscribed' into artefacts conceptualized and built by computer scientists. Although the question of how the 'inscription' (i.e. the gendering) actually occurs, still remains, it becomes clear that the aim of this approach is to avoid gendering processes in technology design. I term those strategies that are capable of fulfilling this general goal 'de-gendering methodologies'. Hence, de-gendering neither aims at a 'gender-neutral' or 'gender-free' technology nor is it geared towards building certain technologies for women (or men), rather, it means to prevent technology design from gendering.

The main challenge of such an approach is, thus, to propose methodological concepts for the design of technologies that reflect gender as a category in the design process. What is required in order to initiate a de-gendering process? How does one design computational artefacts that might be characterized as 'de-gendered' technologies?

A first step to address these questions is to determine a goal, i.e. an envisioned outcome that a de-gendering (design) process should achieve. Starting from feminist theory and feminist STS, there are several options as to what a de-gendered design of information technologies could mean: Should it mitigate existing 'gender scripts' (Akrich 1992; 1995; Rommes 2002) in technologies? Should gender be used as an analytical tool in order to overcome gender as a structure of social ordering (Lorber 2000)? Or should users be enabled to question, undermine and query the binary sex system (Butler 1990)? Should they be supported in reflecting on the social construction of the binary gender system?

In this paper I propose a situated approach, in which the de-gendering strategy is chosen to depend on a close analysis of the technological artefacts in question. I use the gender script approach as an inspiration to identify distinguished gendering processes of computational artefacts. Thus, a categorization of gender scripts will be taken as a basis for suggesting situated de-gendering methodologies.

Gender scripts

Ellen van Oost (1995), Nelly Oudshoorn (1996) and Els Rommes (2000) introduced the concept of 'gender scripts' as a tool to analyze the gendering processes of technology. Gender scripts refer to Madeleine Akrich's (1992; 1995) notion of the 'script' that contains assumptions about the use context that are materialized in the technology, which pre-structure the use of the technology. On this basis, Rommes defines: 'Given the heterogeneity of users, designers will consciously or unconsciously privilege certain representations of users and use over others. When these representations and the resulting scripts reveal a gender pattern, we call them "gender scripts" (Rommes 2002, 17f.). As van Oost (2003, 196) notes, the impact of scripts is neither completely determined nor stable, since on the one hand the content of gender is constantly negotiated and objects that carry gender scripts are actors in the negotiation processes. On the other hand, to conceive of scripts as determining the behaviour of users would be a technological deterministic position. Users do not have to accept the script in the way it is inscribed into the artefact. Rather they can reject or adopt

the script. 'Gender scripts do not force the users to construct specific gender identities, but scripts surely act invitingly and / or inhibitingly' (van Oost 2003, 196).

Oudshoorn's (1996) distinction of gender scripts is of particular interest in this context, where I want to differentiate between strategies for de-gendering computational artefacts. She claims that they can be problematic in four different ways. They can 'delegate different competencies and responsibilities to men and women; they can reinforce differences between female and male work; they can normalize stereotypical male and female behaviour and they can create barriers for the accessibility of technology' (cp. Rommes 2002, 18).

In the remainder of the paper I will discuss to what extent this characterization is a good starting point for classifying de-gendering strategies. In order to relate the categories formed by Oudshoorn's distinction to the three major strands and debates of feminist theory, I merge the first two sets of problems and subsume them under the structural symbolic gender order. In other words, I will discuss three categories of gender scripts more deeply: Barriers in use result from the assumption of a gender neutral technology (liberal approach). Technologies reinforce the structural-symbolic gender order, although they are built specifically for the female user (radical feminism). Other technologies are assumed to represent humans or human behaviour while they normalize gender stereotypical behaviour (constructionist understanding of gender). In the following three sections I will suggest how to invoke de-gendering processes for theses cases by technology design methodologies.

Alleged neutral technology

Designers assume many technologies to be neutral, but a closer analysis reveals barriers in use. One example of these kinds of artefacts are early speech recognition systems in Artificial Intelligence that were not able to recognize female voices, since the designers did not think about the fact that adapting the technology to male voices could exclude female users (cp. Bührer & Schraudner 2006, 6). Another case study, however, shows that even if designers explicitly aim to build technology 'for everyone'

they are still in danger of excluding certain users by design. Els Rommes unmasked the development of the Digital City Amsterdam as a design for hegemonic masculine interests (cp. Oudshoorn, Rommes & Stienstra 2004; Rommes 2000; 2002). She discovered that designers undermined their own agenda 'XS4all' (speak: access for all) by using the 'I-methodology'—a form of implicit user representation. They unconsciously assume that users would have the same technical equipment, knowledge und skills, the same preferences and interests, and thus, see themselves as representatives of the users. Since they often form a homosocial, predominantly masculine group they actually inscribe their own background, knowledge, concerns and attitudes into the technology.

While early speech recognition systems could not be used by women, because of their higher pitched voice, i.e. a more or less biological gender difference, the designers of the Digital City Amsterdam did not question socio-economic prerequisites, such as access to the latest generation of computers, some experience in the use of the internet and the trial-and-error strategy. As Anne-Jorunne Berg (1999) pointed out, such a structural exclusion of women and other 'others' from the use of certain technologies can already occur on the level of problem definitions that underlie technological solutions. Her study of prototypes of 'smart houses' illustrates that the designers were not aware of housework, which is traditionally assigned to the female realm. Rather, they implicitly assume the customer to be a man interested in technology, not unlike the stereotype of the computer nerd.

All these examples illustrate the need for technology design methodologies that take into account a variety of users. Hence, the objective when facing alleged neutral technologies is the inclusion of diverse users, equal access and usability. The methodologies sought after should strive for the acknowledgement of differences, e.g. physical and social gender differences, but also cultural, class, age and other categories.

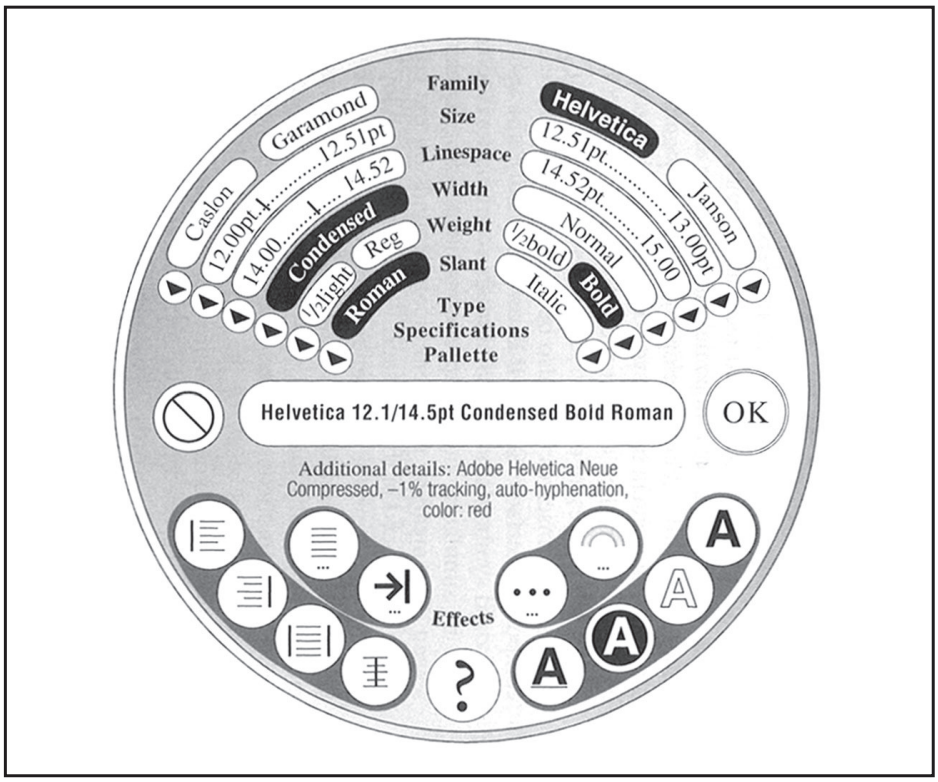
Several subfields of computer science already have a long tradition of developing methods of technology design that aim to avoid the I-methodology. Ergonomics, socio-technical systems design and human-computer interaction focus on getting to 'know the user' (cp. Hansen 1971), in order to build technologies for use and the real user instead of

expecting that users will adapt to already existing technology (cp. Dix et al. 1993; Maaß 1993; Nielsen 1994). In the cases of the Digital City Amsterdam and the smart houses, designers could have conducted usability tests (cp. Oudshoorn, Rommes & Stienstra 2004) to realize that their products do not match the skills, interests and preferences of the envisioned target group of the technology. An alternative design, however, should start with a thorough requirements analysis of the intended users—not in the sense of requirements engineering, but understood as part of an evolutionary or cyclic user-centred design (cp. Beyer & Holtzblatt 1998; Preece et al. 2002). Although it has to be discussed which representatives of the users should be chosen, if the technology is meant to be used by everyone, particularly involving diverse, e.g. female users in the design process seems to be a way of preventing technologists from the mistakes of the I-methodology.

Technologies for 'the female user'

A second class of technologies contains those which are built for specific users, e.g. women as customers or to support women in their workplaces, but which in effect codify gender difference and reinforce the traditional gender hierarchy. Examples of this kind are the round dialogue box for font selection designed by the graphic designer Aaron Marcus (1993) for white American women, which is built upon the assumption that females would prefer curvilinear shapes (see Figure 1a) or the early word processing software Jeanette Hofmann (1999) analyzed, which assumed secretaries to be permanent beginners and by design defined them as technically unskilled users. Other case studies, for instance in the fields of nursing and call-centre service work (Maaß & Rommes 2007; Wagner 1993), show the lack of knowledge on 'invisible work' since these software systems were modelled in a way that fails to adequately support the workflows by technological means. Since 'invisible work' (cp. Star 1991) is often done by women, it is particularly their work that remains undervalued, since designers either ignore its importance for the organization as a whole or its complexity.

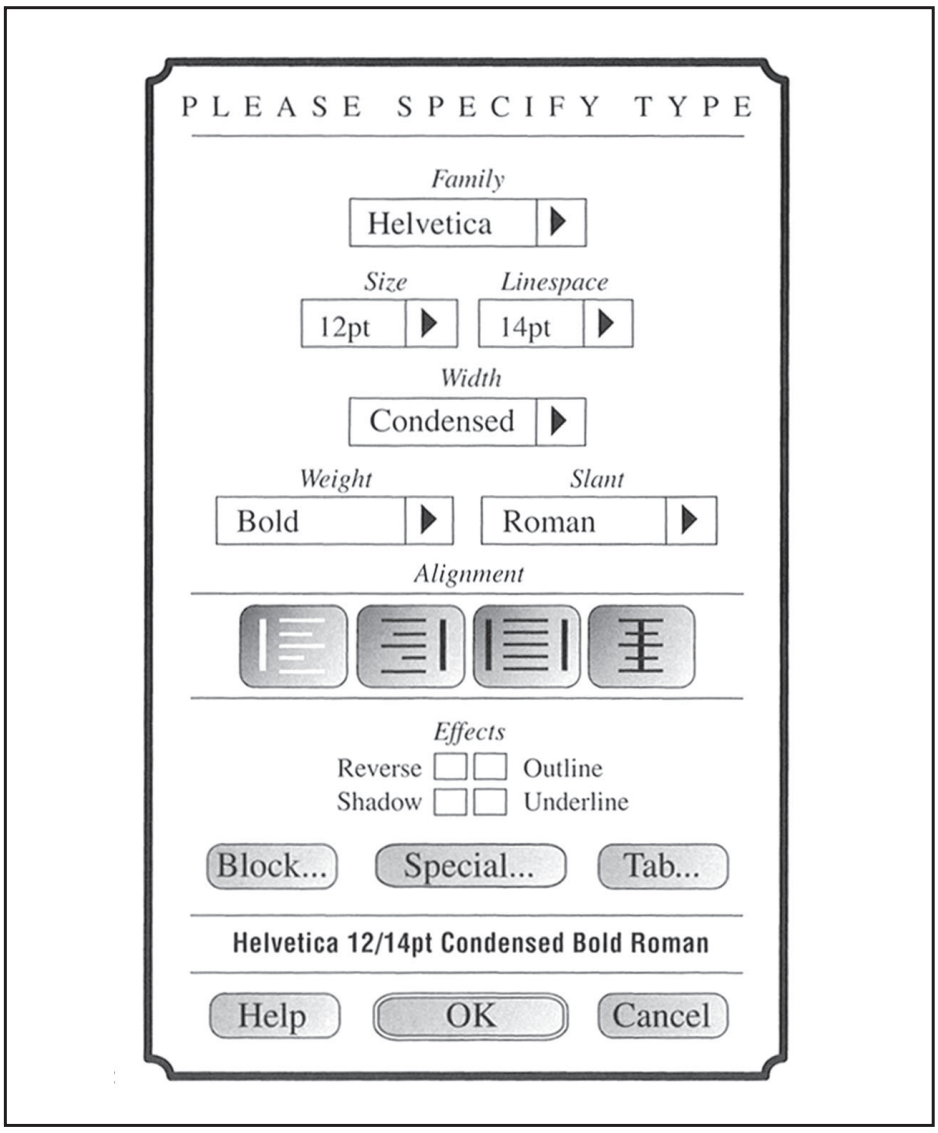
Figure 1a.



Design for women obviously risks celebrating stereotypes about 'women', their preferences, skills and work, which should rather be avoided. A degendering methodology, therefore, has to aim at attributing equal competencies to female and male users and upgrading women's work. Hence, designers should strive to inscribe gender equality into technologies, if they are designed for female users, e.g. at women's workplaces—as opposed to the case of technologies for general use, where they should become aware of gender differences and the diversity of users.[1] As already mentioned, in the latter category of technologies user tests seem to be a useful tool for recognizing that software and user interfaces do not fit the intended real user. In the example of the round dialog box it was demonstrated that, regardless of their gender, all test persons preferred a rather squared and axially symmetrical layout of the dialog box (see Figure 1b, which

was designed for European adult male intellectuals) and strongly disliked the 'female' user interface (Teasley et al. 1994). Thus, the gender stereotype that women like curvilinear features, while men prefer squared ones, was clearly disproved.

Figure 1b.



However, if we want to move from analysis to an alternative design for the cases mentioned above, it is not enough to remain at the level of aiming to map social realities of work, life and use as best as we can, since such approaches tend to reproduce the existing structural-symbolic gender order. Hence, if technologies need to be designed for a predominantly female group of users it takes more than only applying user-centred design methods and evaluating usability. For a de-gendered design of such technologies, an explicit political positioning for those who are structurally discriminated seems necessary. The most well-known research to support workplace democracy and establish better working conditions for workers and employees through the use of technology is the Scandinavian tradition of participatory design (e.g. Bjerknes & Bratteteig 1995). Following this approach, a variety of methods were developed and tested such as future workshops, design games and prototypes (cp. Greenbaum & Kyng 1991). The aims and guidelines to 'design for skill' and 'design for technical empowerment' were already successfully applied in women's workplaces such as nursing, office work or call-centre service work (cp. Bjerknes & Bratteteig 1987; Maaß & Rommes 2007; Schelhowe et al. 2005). Since strategies against deskilling, degrading as well as learning to adapt and to program software in certain contexts work against the traditional gender hierarchy, these participatory design approaches can be considered as de-gendering methodologies if they are enhanced by a critical awareness of the gendered patterns in society and symbolism.

Representation of 'the human' in IT

A third category of gendered technologies include those that represent certain abilities, characteristics or even the nature of 'the human', but actually normalize gender stereotypical behaviour. Persuasive examples are human-like machines that explicitly display human bodies and human behaviour such as anthropomorphic sociable robots or emotional software agents. The bodily appearance of these artefacts, but also their concepts of action / behaviour and interaction / communication were exposed as intrinsically permeated by gender stereotypes (Draude 2005; Weber & Bath 2005).

Against a further consolidation of gender stereotypes, a de-gendering methodology should aim to de-construct the binary sex and gender system. This might be accomplished by artefacts that offer users and designers the possibility to gain an understanding of gender (and technology) as a social construction and instable, constantly performed and negotiated categories.

A design philosophy that 'allows users to engender themselves, to attribute to themselves a gendered identity of any one of a number of sorts, to create or perform themselves through using technology' (Cassell 2002, 204) is 'underdetermined design' (ibid.). While these ideas were primarily directed at encouraging gender identity formation in computer games for children that transcend gender stereotypes, 'technology as experience' (McCarthy & Wright 2004) is an experimental account addressing 'felt life', which serves as a basis for broader design methodologies. 'Design for experience' (Sengers 2004; Sengers et al. 2004), as opposed to designing experience into an artefact, focuses not only on the subjective experiences (e.g. sensual, emotional, compositional, spatio-temporal) of the users, but also opens up space for potentiality and meaningfulness, i.e. a plurality of meaning construction processes that should not be closed or specified by design. 'Reflective Design' (Sengers et al. 2005) goes one step further in stating that 'reflection should be a core design outcome of HCI' (ibid, 49). Reflection, in this case, is to be understood as critical reflection that renders users aware of unconscious aspects of experience. The methodology consists of principles and strategies, which combine the analysis of the ways technologies reflect and perpetuate unconscious cultural assumptions (such as the politics of race, gender and economy) with the design, building and evaluation of computational artefacts that reflect alternative possibilities. To my mind, this approach to provide technical support for self-reflection can be productively used to raise an awareness of gender stereotypes internalized by users, designers and artefacts.

Shortcomings and limitations of the gender script approach

Although the gender script approach seems to be an inspiration for thinking about de-gendering methodologies, the three strategies proposed so far bear several theoretical and practical shortcomings. As feminist scholars have already pointed out, strategies of inclusion and efforts to provide equal access to technologies risk arguing for technological determinism. Furthermore, they tend to reduce 'gender' to 'women' and consider exclusionary phenomena as a problem that women have, while they do not question technology and the design process. De-gendering methodologies which, according to the second category, aim to make visible and revalue competencies, skills and work assigned to the female realm, on the other hand, are in danger of re-essentializing gender by focussing on binary differences. Moreover, some assume an oversimplified view of being able to build emancipatory intentions into technological artefacts. The third approach of deconstructing gender through the use and design of technology has its limits with regard to where it can be applied, since a design for opportunities does not help to design technical support for specific tasks to be fulfilled, for instance, in workplaces. Additionally, a design for self-reflection can easily be shifted to support self-management and, thus, fosters neoliberal strategies to build 'technologies of the self' (Foucault).

My main critique of the gender script concept, however, goes beyond traditional arguments from feminist or social theory and draws on recent STS debates. As it retains the 'co-construction of gender and technology' approach, the concept is neither able to capture the distributed agency between humans and machines, nor the distributed responsibility that is implied by such an actor-network approach. This limitation of the gender script concept refers to crucial research lacunae in the analysis of gender-technology relations as well as in the technology design approach aiming at a de-gendering, which relies on the former. Recognizing distributed agency might improve and refine the analysis of the gendering processes described above. Furthermore, such a perspective seems to be an essential prerequisite if we want to understand the gendering of those

artefacts that intrinsically inscribe skills that have so far been considered to be 'human' into machines. Examples where such an account becomes particularly relevant are areas of computer science that work with concepts of Artificial Intelligence or essentially rely on epistemology and ontology. In its focus on user representations, which presuppose a software application, an information system or user interface, the gender script concept fails, for instance, to explain the gendering of modelling methods (e.g. object oriented analysis and design, cp. Crutzen & Gerissen 2000), information representation and classification (e.g. semantic technologies, ontologies, cp. Adam 1998) or concepts of 'the human' in human-like machines (e.g. plans and Cartesian agency, cp. Suchman 2007). It seems to be these computational artefacts, however, that might radically transform what we can see, how we can think, feel and interact socially.

Based on these insights, I am arguing for a new approach that

- is not based on essential distinctions between humans and non-humans (e.g. that is able to analyze how humans and machines are constituted and how agencies are distributed between them),
- is—at the same time—aware of the politics of artefacts (e.g. its gendering) and
- imagines new forms of (feminist) intervention in socio-material—or material-discursive—techno-scientific practices (e.g. the de-gendering of information technological artefacts).

Proposing an enhanced theoretical framework

Actor-network theory seems to be a theoretical framework that takes the distributed agency and entanglements of the technical and the social into account without essentializing differences between human and non-human. Its understanding of heterogeneous networks and hybrids, particularly its appreciation of the cyborg in the feminist reformulations of this approach (cp. Haraway 1991; 1994) can form a basis to move beyond technological and social determinism, in which the implications of the gender script approach tend to be caught. To analyze computational artefacts, however,

Karen Barad's 'agential realism' (1998) appears to be even more productive, since it not only dissolves the theoretical shortcomings of realism and constructivism. Compared to Haraway, who eventually focuses on narratives, Barad emphasizes that 'matter matters' and locates alternatives, i.e. resistance within contemporary techno-sciences. In contrast to Latour's anthropological symmetry (cp. Latour 1993), she believes that there is an ontological asymmetry between human and non-human. Thus, her approach 'provides an understanding of the nature of scientific practices which recognizes that objectivity and agency are bound with issues of responsibility and accountability. We are responsible for what exists, not because it is an arbitrary construction of choosing, but because agential reality is sedimented out of particular practices that we have a role in shaping' (Barad 1996, 7).

Lucy Suchman translates Barad's approach more concretely to the computer science discipline in stating that '[a]gencies—and associated accountabilities—reside neither in us nor in our artifacts but in our intra-actions. The question, following Barad, is how to configure assemblages in such a way that we intra-act responsibly and generatively with and through them' (Suchman 2007, 285). All three authors—Haraway, Barad and Suchman—aim at an accountable approach to the analysis and design of techno-scientific artefacts. Hence, their concepts together provide a theoretical framework for rethinking current human-machine relationships from a perspective of responsible technology design called for above. The proposed new framework however requires a re-conceptualization of gendering and de-gendering processes.

Re-conceptualizing the (de-)gendering of computational artefacts

The approach aimed for here is one that allows to capture the redistribution of agencies between humans and machines and at the same time acknowledges the politics, e.g. gendering of artefacts. Barad's concept of 'posthumanist performativity' (2003) appears to be appropriate for this purpose. Posthumanist performativity is a posthumanist and materialist

reworking of Judith Butler's notion of 'performativity' developed within the context of feminist theorizing of the body, according to which sex is an always contested materialization of gender norms. Barad, however, criticizes that Butler understands matter (i.e. the body) as a passive product of discursive practices rather than conceiving it as an active agent participating in the process of materialization. She stresses that 'matter is not simply "a kind of citationality", the surface effect of human bodies, or the end product of linguistic or discursive acts. Material constraints and exclusions and the material dimensions of regulatory practices are important factors in the process of materialization' (Barad 2003, 822). Her approach is 'a robust account of the materialization of all bodies—"human" and "non-human"—and the material-discursive practices by which their differential constitutions are marked' (Barad 2003, 810). Hence, her approach fits perfectly into the enhanced framework, while at the same time enabling us to theorize the gendering of artefacts, which can now be conceptualized as a *co-materialization* of 'matter' (or computational artefacts, repectively) and gender. Thus, the concept of 'posthumanist performativity' bears not only the potential to describe gendering processes of software applications, information systems and user interfaces, but also those of 'technologies-in-the-making', methodologies and basic research.

The problem that arises now, however, is the question which de-gendering strategies might counter, for instance, the gendering of modelling methods, the representation of information representation or concepts of the human. What can de-gendering in the constructive sense of technology design on the basis of such an account mean? From a computer science perspective, Agre (1997) proposes a 'critical technical practice', which mainly consists of the strategy of inverting core metaphors. And Suchman argues from a science and technology studies perspective in favour of making 'accountable cuts', i.e. cutting the network responsibly to create socio-material assemblages as objects of analysis and intervention, and 'expanding frames' (Suchman 2007, 283). The challenge is now to develop, explore and evaluate methodologies that make interdisciplinary translations between computer scientists, gender studies researchers and STS scholars productive by putting Barad's and Suchman's account into the practice of technology conceptualization and design.

Note

[1] Here it becomes obvious that technologies reflect the well-known paradox of early feminist politics, aiming at equal opportunities (i.e. assuming gender equality), while at relying on—partly essentialist—distinctions between women and men, the female and the male realm (i.e. assuming gender differences). In order to resolve this paradox I suggest to move beyond an abstract category of technology. De-gendering strategies should rather be situated in the particular context of the artefact. A rough distinction might be whether the technology is designed for everyone (i.e. assumed neutral) or built for female (or male) users (i.e. assumed to address differences). Though this taxonomy does neither include—as we will see—'technologies of the self' nor technological concepts on epistemological levels.

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