

# Searching for Methodology

## Feminist Technology Design in Computer Science

---

CORINNA BATH

The objective of this article is to provide methods for technology design that avoid a perpetuation of the existing structural-symbolic gender order. Moreover, by aiming for a systematic approach to conceptualizing and building computational artefacts, it seeks to identify a feminist methodology in the field of computer science. The core argument of the contribution is that methods for counteracting problematic gendering mechanisms need to be differentiated. Thus the main part of the article is arranged along an analysis of gendering processes.

Based on a review of existing science and technology studies (STS) research, four mechanisms are described that often lead to gendered computational artefacts: 1) the 'I-methodology' that assumes technology to be neutral; 2) the inscription of implicit gender stereotypes and the gendered distribution of labor into computational artefacts; 3) the gendered technological concepts of human bodies and behaviors; and 4) decontextualization and disputable epistemological or ontological assumptions. For each of these mechanisms I will propose technology design methods adopted from the field of critical computing,<sup>1</sup> and outline in which way these methods can avoid problematic

---

1 | Critical computing refers to a field that can be characterized by the series of decennial conferences called critical computing (see Bertelsen et al., 2005), where researchers and designers from a variety of critical approaches to computing (e.g. participatory design, values in design or the German theory of computer science / 'Theorie der Informatik') meet.

ways of gendering. Finally, the potential and limitations of the methods and the methodology as such are discussed on the basis of feminist theory.

## INTRODUCTION

During the last decades the corpus of knowledge about gender *in* technology has been growing continuously. Numerous case studies show in detail how gender configurations and is configured by the design of technology (see for example Archibald et al., 2005; Cockburn, 1986; Cockburn and Ormrod, 1993; MacKenzie and Wajcman, 1999; Oudshoorn and Pinch, 2003; Wajcman, 1991; Zorn et al., 2007). Though several comparative studies aimed at a critical review of the underlying theoretical concepts of gender in the gender-technology literature, particularly in case studies (e.g. Faulkner, 2000; Gill and Grint, 1995; Wajcman, 2007) that have been conducted, there is still a lack of a thorough overview that focuses on the *processes* of gendering technology. A deeper understanding of the mechanisms that are at work when technological artefacts are gendered, however, is a crucial prerequisite for making suggestions for an alternative design that might be called feminist. In order to be able to change the design of artefacts and apply more appropriate design methods, designers of technologies need to know in which sense their artefacts might be problematic.

The gender category and, therefore, the gendering of technological artefacts is, however, a somewhat intricate subject. Some technology designers tend to ignore gender. For example, Anne-Jorunne Berg (1999) pointed out that a designer of smart houses thought of the target consumers as 'everyone', while her study revealed that these artefacts were designed for the technically interested male user and not for supporting, for example, housework. Other technical designs – such as lady shavers (Van Oost, 2003) or the Volvo concept car (Temm, 2008) – explicitly take gender into account. This approach to design becomes problematic when gender stereotypes are built into technology, for instance when the design mirrors the assumption that women are technologically incompetent,<sup>2</sup> while the assumption of gender neutral technology is

2 | For example, Van Oost (2003) shows in her historical study that Philips shavers were not only gendered by design (e.g. pink vs. black or metallic colors), but also by functionalities. Whereas the Ladyshave can hardly be opened without destroying the device, men's Philishave has screws to open it and a display that conveys technical information to the user. Van Oost concludes that Philips shavers not only reflect the gendering of

particularly disputable, when it is assumed that the artefact addresses 'everyone' without explicitly taking notice of gender and other differences. For the latter case it has been shown that gender is often an implicit element of the design process in the sense that certain user groups have to make a greater effort than others in order to access the technology or to make the use of artefacts meaningful for them (Oudshoorn et al., 2004).

These two forms of gendering were already well-described by the concept of the gender script that distinguishes between explicit and implicit notions (see Van Oost, 2003; Rommes, 2002). Rommes, moreover, specified the mechanism behind implicit gender scripts. She pointed out that designers unconsciously base their design choices on their own preferences, interests, and competencies. Referring to Akrich's early use of the term, artefacts thus often become biased and one-sided due to the so-called "I-methodology" (Akrich, 1995).

So far, the gender script concept and its related gendering mechanisms, stereotyping, and 'I-methodology', seem to be a good starting point to understand gendering processes in technology design. However, the existing 'gender-in-technology' literature provides insights also into other gendering mechanisms that defy explanation by the script concept. One gendered impact of technologies which the script concept can hardly describe are the substantial effects that some computational artefacts such as concepts of humanness in Artificial Intelligence (e.g. Suchman, 2007) or human-like artificial characters (e.g. Weber and Bath, 2007) can have on the users' subjectivities. The genderedness of these artefacts cannot be understood merely as a form of stereotypes, i.e. an association of certain qualities and competencies with femininity or masculinity, since they tend to normalize gender and re-establish the two-sex-system itself. Moreover, such effects are not necessarily related to the designers' visions of use and users that are essential for the definition of the gender script. By focusing on the designers' *user* representations, gender scripts can neither explain the gendering of human bodies and behavior, nor does it capture modelling methods such as object orientation, classifications schemes or dichotomies underlying technology designs. These artefacts, though, have been proven to have (gender) politics, too (see Bath, 2010; Bowker and Star, 1999; Crutzen and Gerissen, 2000). Hence, looking at computational artefacts, not in the narrow sense of technologies and products, but also including con-

technological competence, they also construct and strengthen the prevailing gendering of technological competence. "In other words: Philips not only produces shavers but also genders" (Van Oost, 2003: 206).

cepts and material-symbolic entities produced by those who work in computing, raises the awareness for gender analysis in the field of technology. Extending the framework to gendered technological concepts and assumptions contributes productively to the search for a feminist design methodology, because counteracting the related gendering mechanisms might be even more effective and substantial than only avoiding gender scripts.

In the remainder of this paper I will discuss four categories of computational artefacts (and their related gendering mechanisms) that have been introduced so far: alleged neutral technologies for 'everyone', technologies for the female user, representations of 'the human' in IT and abstract concepts/basic research. This distinction will be explored further in the next section which argues that there is a strong relationship between the categories of artefacts chosen, a certain gendering mechanism and a certain strategy of counteracting this gendering mechanism. In the main part of the paper each of the four categories is discussed in detail: it starts with the gendering mechanism that is likely to occur and gives examples from feminist STS research that illustrate this process. As a next step, a feminist political-epistemological strategy is suggested that might avoid such a gendering. Finally, possible technology design methods borrowed from critical computing are introduced that appear suitable to implement the chosen strategy in a concrete design process. Taken together, these four sections aim at a methodological framework that integrates systematic gender analysis based on STS research with technology design into computer science. However, such a pragmatic approach can only form a complete methodology if it is reflected upon on the basis of feminist theory and politics. The potential and limitations of the technology design procedure suggested will be evaluated in the last section. The concepts from feminist research that are needed to give the approach a theoretical foundation are introduced in the following section.

## DE-GENERATING COMPUTATIONAL ARTEFACTS: THEORETICAL FOUNDATIONS FOR COUNTERACTING GENDERING MECHANISMS

The methodology proposed in this article aims at avoiding the reproduction of the existing structural-symbolic gender order and rupturing its further stabilization by technology design. I call this objective 'de-gendering computational artefacts'. This term does not imply that there can be a gender-free zone or a gender-neutral artefact. Speaking with Judith Butler, entities – like bodies –

cannot escape ongoing processes of gender signification and resignification (Butler, 1993). Judith Lorber argues that using more than two polarized categories of sex, sexuality and gender makes research more accurate. The term 'de-gendering' refers to her political goal of going beyond binaries (Lorber, 2000, 2005). In this context it is rather meant as an attempt to challenge those designers who assume that their artefacts were gender-neutral, because it postulates that technological artefacts were already beforehand in some ways gendered. The term is also chosen as a counterpoint to some recent initiatives that intend to 'gender' technological artefacts by considering women's interests or demands in the design and thus producing a new essentialism (see e.g. Bührer and Schraudner, 2006). 'De-gendering computational artefacts' is therefore an intervention on several levels. As such it requires a theoretical foundation.

It has already been mentioned that the gender script concept, which is often used to capture the concrete processes of gendering technology, is not sufficient to describe certain gendering processes of computational artefacts. For instance, it cannot be applied to concepts of human behavior or ontological and epistemological assumptions in technology design, because of its focus on user representation. To understand the gendering of artefacts on such a conceptual level, I propose applying Barad's concept of 'posthumanist performativity' (Barad, 2003). Barad describes posthumanist performativity as a materialist and posthumanist reworking of Judith Butler's notion of performativity (Butler, 1990, 1993). Butler developed this notion within the context of feminist theorizing of the body by stating that sex is a materialization of gender norms that is contested at all times. Barad agrees to the procedural character of gendering and the relevance of existing social norms that change during the process. However, she 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. By contrast, posthumanist performativity, 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). On this basis the gendering of artefacts can be conceptualized as a co-materialization of matter (or computational artefacts, respectively) and gender. This concept allows for a description of the gendering of software applications, information systems, and user interfaces, but also the gendering of concepts and assumptions in technology design, modelling methods, and basic research.

In her concern to de-emphasize the discursive and linguistic aspects within feminism and within STS research, Barad stresses the relevance of "taking

matter seriously" (Barad, 2007: 132). Posthumanist performativity is framed by her "epistem-onto-logical" theory of "agential realism" (Barad, 1996a, b, 2007) that she developed by drawing on as well as fundamentally criticizing and further developing the actor-network theory, particularly the version of the feminist technoscience researcher Donna Haraway. Along this line of thinking, Barad conceives the relationship between humans and non-human artefacts as a complex and heterogeneous network – or hybrid, without presuming essential differences between humans and artefacts. However, she stresses to keep in mind that this relation between human and non-humans is always asymmetric. "Agential realism acknowledges the agency of both subjects and objects without pretending that there is some utopian symmetrical wholesome dialogue, outside of human representation." (Barad, 1996b) This would not mean that authorship lies in the hand of humans only, on the contrary: "the world kicks back" (Barad, 1998: 112). Agential Realism therefore concentrates on "real consequences, interventions, creative possibilities, and responsibilities of interacting with the world" (Barad, 1996a: 8).

Lucy Suchman (2007) translates Barad's account from physics to computational artefacts. Against the background of Artificial Intelligence, a field that she studied thoroughly, she also calls for acknowledging the specific agency of humans in processes of mutual configuration of humans and technologies, without reiterating traditional humanist notions of autonomous human agency, which essentialized differences between human and machines. Moreover, she takes Barad's concern a step further by emphasizing this notion of accountability that also includes boundary-making between humans and machines. "The accountability involved is not, however, a matter of authorship in any simple sense, but rather a problem of understanding the effects of particular assemblages and assessing distributions, for better and worse, that they perform." (Suchman, 2007: 271) In this instance she refers to Barad: "We are responsible for the world in which we live not because it is an arbitrary choosing, but because it is sedimented out of particular practices that we have a role in shaping." (Barad, 1998: 102) Suchman argues that an asymmetrically distributed agency between humans and the non-human implies understanding responsibilities as also being asymmetrically distributed. "Agencies – and associated responsibilities – reside neither in us nor in our artefacts, but in our intra-actions. The question, following Barad, is how to configure assemblages in such a way that we can intra-act responsibly and generatively with and through them." (Suchman, 2007: 285)

'De-gendering computational artefacts' is based on this broad theoretical account opened up by Barad and Suchman. It aims at taking agencies and responsibilities in socio-material assemblages of humans and artefacts seriously. 'De-gendering computational artefacts' is inspired by Suchman's (2007) suggestion of making 'accountable cuts' as a strategy of analysis and intervention. Choosing four characteristically problematic gendering mechanisms and their related artefacts as a starting point here should be seen as a form of preparation for cutting a concrete network of humans and artefacts in a responsible way. However, every design process requires a thorough analysis of the gendering at work. The approach that will be proposed in this paper also applies the second strategy that Suchman (2007) suggests: 'expanding the frames'. While she proposes to disenchant the effects by zooming out to a wider view and explicating the hidden labor and contingencies, 'de-gendering computational artefacts' aims to move forward from gender analysis towards feminist design. It is argued there that each category of artefacts not only correlates with a certain gendering mechanism, but requires a certain political-epistemological positioning towards gender. This means that designers have to decide what kind of change in the structural-symbolic gender order they intend to address when aiming to counteract the identified gendering in their designs.

My suggestion for this part is mainly borrowed from feminist theory and politics, which distinguishes strategies such as achieving gender equality, acknowledging differences or deconstructing gender (see for instance Gill and Grint, 1995; Maass et al., 2007; Wajcman, 2007). While these approaches generally conceptualize gender or the gender-technology relationship, my idea is to translate such strategies into technology design and its gendering. For instance, feminist theory interprets the gender equality approach (liberalism) as aiming to get more women into computer science and engineering, whereas I suggest analyzing whether artefacts should produce gender equality by design. Hence, I propose to determine a goal as a first step of a feminist (design) process. This goal, the envisioned outcome, should be situated and chosen according to the computational artefact in question. Considering the four categories of computational artefacts discussed above, there are several options as to what counteracting the gendering of computational artefact can mean: in the case of alleged neutral technologies that ignore certain user perspectives the best counter-strategy seems to be that designers acknowledge differences between users. This means that these artefacts call for a gender-difference approach, in order to provide equal access and meaningfulness. In the second type of technologies intended for women, it can be suggested that artefacts

should support issues assigned to the female realm as much as those traditionally considered as masculine. This means that these artefacts call for a gender-equality approach, in order to overcome gender differences and hierarchies. The third category of artefacts that contribute to identity-building or even more changing subjectivities indicates that technology should enable users to question and reflect on the existing binary sex and gender system. Thus, a deconstructionist approach seems to be a good choice here, in order to avoid a further normalization of existing gender patterns. Many gendered concepts of the fourth category require a re-contextualisation before critical and interventionist strategies can be applied. It depends on the context revealed whether the alternate design should rather aim at changes in epistemological or ontological assumptions or both, and if this refers to one of the goals mentioned above.

In the following four sections the four categories of artefacts introduced are described in detail. For each gendering mechanism I will propose technology design methods from the field of critical computing.

### ALLEGED NEUTRAL TECHNOLOGY AND THE 'I-METHODOLOGY'

Designers assume many technologies to be neutral, but a closer analysis reveals barriers in use. An example of these kinds of artefacts are early speech recognition systems in Artificial Intelligence that were said to not have been capable of recognizing female voices, since the designers did not think about the fact that adapting the technology to male voices could exclude female users. A more serious case study 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 revealed the development of the Digital City Amsterdam as a design for hegemonic masculine interests (Oudshoorn et al., 2004; Rommes, 2002). She discovered that designers undermined their own agenda 'XS4all' (pronounced 'access for all') by using the 'I-methodology' – a form of implicit user representation. They unconsciously assumed that users would have the same technical equipment, knowledge and 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 this gendered background and knowledge, their concerns and attitudes into the technology.

The example of the early speech recognition systems refers to a (more or less) biological gender difference. It is argued that these artefacts could not be used by women, because of their higher-pitched voice. Rommes, in contrast, draws on socio-economic factors to demonstrate that the Digital City Amsterdam was gendered. Designers did not question essential, but gendered prerequisites, such as access to the latest generation of computers, a certain experience in the use of the Internet and the trial-and-error strategy. As Anne-Jorunne Berg 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 (Berg, 1999). Her study of smart houses illustrates that the designers were not aware of housework that is traditionally assigned to the female realm. The interviews revealed that 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 should be the inclusion of diverse users, equal access, and usability. The methodologies sought after should strive for the acknowledgement of differences, for example, physical and social gender differences, but also in terms of ethnicity, race, nation, 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, in order to build technologies for use and the real user instead of expecting that users will adapt to already existing technology (see for instance Dix et al., 1993; Nielsen, 1994). In the cases of the Digital City Amsterdam and the smart houses, designers could have conducted usability tests to realize that their products do not match the skills, interests, and preferences of the technology's envisioned target group (Oudshoorn et al., 2004). According to the field of human-computer interaction, however, an alternative design should start with a thorough requirements analysis of the intended users – not in the sense of allowing them only to test prototypes and end products, but involving them from the very start of the design process, which should be understood as an evolutionary or cyclic user-centred design (see for example Beyer and Holtzblatt, 1998; Preece et al., 2007). 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 a diversity

of female users in the design process seems to be a way of preventing technologists from repeating the mistakes of the 'I-methodology'.

### TECHNOLOGIES FOR 'THE FEMALE USER', STEREOTYPES AND THE GENDERED DIVISION OF LABOR

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 for white American women, which is built upon the assumption that females would prefer curvilinear shapes (Marcus, 1993), or the early word processing software Jeanette Hofmann analyzed, which assumed secretaries to be permanent beginners and by design defined them as technically unskilled users (Hofmann, 1999). Other case studies, for instance in the fields of nursing and call-centre service work, 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 (for example Maass and Rommes, 2007; Wagner, 1993). Since 'invisible work' is often done by women (Star, 1991), it is particularly their work that remains undervalued, since designers either ignore its importance for the organization as a whole or its complexity.

Design for women obviously risks celebrating stereotypes about 'women', their preferences, skills and work, which should be avoided. A de-gendering 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, for instance 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. 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 dialogue box it was demonstrated that, regardless of the gender, all test persons preferred a squared and axially symmetrical layout of the dialog box 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 disproven.

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 possible – as it is often assumed in computer science modelling, 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 against 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 and Brateteig, 1995). Following this approach, a variety of methods were developed and tested such as future workshops, design games, and prototypes (see for instance Greenbaum and 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 (see Maass and Rommes, 2007; Wagner, 1993). Since strategies against deskilling, degrading or learning to adapt and to program software in certain contexts work against the traditional gender hierarchy, these participatory design approaches can be regarded 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 AND THE PERPETUATION OF GENDER NORMS

A third category of gendered technological artefacts include those that represent certain abilities, characteristics or even the nature of 'the human', but actually normalize gender-stereotypical behavior. Persuasive examples are human-like machines that explicitly display human bodies and human behavior such as anthropomorphic sociable robots or emotional software agents. The bodily appearance of these artefacts, but also their concepts of action/behavior and interaction/communication were exposed as intrinsically permeated by gender stereotypes (e.g. Draude, 2005; Weber and Bath, 2007).

Against a further consolidation of these genderings, 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 social constructions 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, 2003: 204) is ‘underdetermined design’. While Cassell’s ideas were primarily directed at encouraging gender identity formation in computer games for children that transcend gender stereotypes, “technology as experience” (McCarthy and Wright, 2004) is an experimental account addressing ‘felt life’. Rooted in phenomenology, this theoretical approach serves as a basis for some 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 processes that construct meaning and which should not be closed or specified by design. ‘Reflective Design’ goes one step further in stating that “reflection should be a core design outcome of HCI” (Sengers et al., 2005: 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 technology reflects and perpetuates 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. It aims at providing support for self-reflection. To my mind, this approach could be productively used to raise an awareness of gender stereotypes internalized by users, designers, and artefacts.

## FORMALISMS, ABSTRACT CONCEPTS, AND BASIC RESEARCH: DE-CONTEXTUALIZATION AND OBJECTIVISM

A fourth category of computational artefacts includes algorithms, formal objects, and conceptual approaches in computer science that can be said to have

gender politics. Abstraction, formalization, and classification produce the impression of objectivity and a neutral research subject. Here, it seems problematic that these processes inevitably entangled with computer scientists’ work disguise explicit and implicit decisions made in the process of technology design, while they in effect establish hierarchies of knowledge, gendered classifications or dichotomies. Striking examples of this kind of gendering mechanism are the mathematical tools used to transform raw data from a computer tomograph into colored pictures of the brain. It has been shown (Kaiser et al., 2004) that depending on the algorithm and threshold chosen gender differences of the brain appear – or do not appear. Thus, formalization is not innocent. A field where this has also been demonstrated is the representation of knowledge. For instance, CYC, a knowledge-based system, which received a huge amount of research funding over 10 years during the 1980s in the US, aimed to codify common sense knowledge. However, only declarative knowledge has been taken into account, whereas procedural knowledge has been ignored. Alison Adam and Catherine Sheirron complain that the knowledge, which is excluded from formal representation, corresponds with the knowledge that is traditionally assigned to the female realm (Adam, 1998; Sheirron, 2000). Moreover, CYC assumes a universal subject of knowledge. Contrary to feminist insights into the situatedness of all knowledge (e.g. Haraway, 1988), it is taken for granted that all knowers share the same reality, “be they a professor, waitress, a six-year-old child, or even a lawyer” (Lenat and Guha, 1990, according to Adam, 1998: 85). Recent formalization projects such as the Semantic Web or Linked Open Data encounter similar problems (see Bath, 2013). Another exemplification of the category of formalisms, abstract concepts, and basic research are dichotomies that underlie computational concepts that might be symbolically gendered such as the dualisms of mind and body or rationality and emotionality. Attempts to overcome these dichotomies, e.g. in artificial intelligence, often consolidate a new, but also deeply gendered symbolic order (see for instance Bath, 2010).

A de-gendering strategy for these formal objects presupposes a re-contextualization in use and in structural as well as cultural effects. It requires questioning assumptions, ontologies and epistemologies of technology design, and a dissolution of dichotomies. Since such gendering processes do not necessarily refer to users and use, alternative technology design methods should mainly involve designers.

‘Mind Scripting’ (Allhutter, 2012) is an approach to identify presumptions and gender scripts in the process of designing technology. The technique is

based on Frigga Haug's "memory work" that uses one-page long texts written by group members to deconstruct shared experiences and assumptions reflecting societal structures (Haug, 1999). "Mind Scripting" transfers this idea, which originated in the consciousness-raising groups of the 1970s, to present groups of technology designers (Allhutter, 2012). "Value Sensitive Design" (Friedman and Kahn, 2003) is a method that aims to inscribe certain desired values such as equity, diversity, and inclusion into technological artefacts. It contains three levels of inquiry: empirical, technological and, most notably, conceptual studies that are based on moral philosophy and ethics. However, the method was already applied to computer game design by feminist scholars (e.g. Flanagan et al., 2007). Particularly in order to undermine or resolve dichotomies that are gendered in western traditional thought and connected to technology design, "Critical Technical Practice" (Agre, 1997) can be a helpful tool. This method suggests analyzing designers' discourses, in order to identify key metaphors and then to invert these terms. It results in bringing in the margin to the center of technology design. For instance, Agre and Chapman (1987) developed a system, in which the model of abstract cognition that was dominant in Artificial Intelligence during the 1980s was replaced by a situated action approach that implemented Suchmans' theoretical account. Another technique to question and change concepts of basic research in computer science are interventionist laboratory studies. As a form of anthropological inquiry commonly used in science and technology studies (STS) laboratory studies are interventionist as such. However, applied to the context of basic research in computer science, this method can be explicitly guided by feminist goals in design such as the ontological and epistemological 'de-gendering of computational artefacts'. This has been explored by own research in the field of anthropomorphic software agents (see for example Weber and Bath, 2007). Hence, there are already a few techniques that seem promising to use, in order to re-contextualize formal objects and replace questionable ontological and epistemological assumptions in basic research in computer science.

## CRITICAL AND FEMINIST RE-READING OF THE METHODOLOGICAL FRAMEWORK

The approach that has been roughly presented in the last sections aims at a basic methodological framework for feminist technology design in computer science. It provides a broad spectrum of methods helpful for 'de-gendering

computational artefacts'. The suggestions are based on a thorough and systematic analysis of gendering processes. It can, however, only become a methodology, if it is critically re-read from the feminist theory perspective introduced at the beginning and evaluated in practice. This section discusses theoretical traps and possible empirical improvements of the four strands.

When technologies are created 'for everyone', designers often inscribe their own mental models into the technology. To avoid a gendering of the artefacts resulting from such an 'I-methodology' it was proposed to apply methods from user-centered design. Such a de-gendering strategy is based on a gender equality argument and aims at the inclusion of users. Therefore, this strategy tends to essentialize alleged differences between women and men. In order to accomplish that, diversity and particularly gender differences have to be recognized. Involving diverse users and considering intersectional exclusions might support avoiding such traps. A second argument that needs to be taken into account when applying user-centered design for de-gendering purposes to this type of artefacts is that the method only has the potential to adjust the technology to users by empirical means. If the users involved, however, perform and perceive gender in a very traditional way, for instance, strictly binary or stereotyped, this method cannot bring critical, deconstructive impulses to technology design. Therefore, the participation of different users might extend design perspectives for products that better meet the expectations of certain users. However, these methods do not necessarily bring a gender-critical approach to design.

Inscribing gendered images of use, users, and the division of labor into computational artefacts was identified as a second gendering mechanism that often occurs in the design of technologies intended for female users. To counteract stereotypes and gendered hierarchical patterns in such processes, participatory design methods were suggested. Especially approaches from the Scandinavian tradition appear to be appropriate here, since they challenge existing societal structures of inequality and, thus, avoid reproducing the structural gender order by technological means. However, these approaches sometimes imply a rather simplistic view in how far emancipatory ideals can be built into technology. STS and media studies views can help to correct such narrow interpretations. It can moreover be put forward that applying these techniques often means to aim at making visible and revaluing women's work and competencies. From a feminist perspective this means that the strategy tends to re-essentialize gender. It is also problematic, since it aims to make aspects of work visible that should rather be hidden from a political perspective (see for



example Bowker and Star, 1999). Thus, the participatory design approach, too, needs a second reflection when adapted for de-gendering purposes.

The third de-gendering strategy addressed representations of 'the human' in IT, which tend to normalize gender stereotypes. In order to deconstruct not only such gendered assumptions inscribed into the artefacts, but also the underlying binary sex and gender system, it was proposed to combine 'reflective design' and 'design for experience' with insights of current gender studies. Both of these design approaches are based on a constructivist epistemology. They furthermore combine technology design with critical social theory. These methods can therefore easily be connected with current feminist theory and deconstructivist approaches. However, they have so far not been applied as de-gendering strategies. Beyond that, it is an open question whether 'reflective design' and 'design for experience' can be applied to a broader scope of technologies. Since the first two types of artefacts discussed in this paper tend to essentialize gender, deconstructivist approaches might also be promising methods to avoid the gendering of such technologies. It has to be explored whether there are more suitable techniques to deconstruct the binary sex and gender system by technology design in these cases.

The methods proposed to avoid the gendering of formal objects and basic research in computer science need further empirical evaluation. Most of these methods require either a practical implementation to explore, whether they can serve as a de-gendering strategy, or whether they were originally developed for guiding software development and not for revealing problematic presumptions in technological concepts. It is the question whether they can be transferred to formalisms, abstract concepts, and basic research, and what they can contribute to re-contextualising artefacts, counteracting disputable epistemological and ontological assumptions in the design process or resolving traditional dichotomies in basic technological concepts. Particularly in this area there is need for further research on de-gendering methods.

In summary, this paper introduced a systematic approach to feminist technology design. It presented a starting point for a general methodology to counteract the gendering of computational artefacts that goes far beyond existing suggestions, which so far have been either restricted to software applications or to problematic guidelines. The proposed de-gendering approach takes into account the complex gendering processes, which might occur in the field of computational artefact design. It clarifies for what cases well-known design methods from the field of critical computing such as participatory design are

likely to support de-gendering processes. 'De-gendering computational artefacts' furthermore suggests design methods for those artefacts that have rarely been addressed, in order to avoid gendering by earlier methods. In critically reconnecting this approach with feminist theory we should be cautious not to use it as a simple recipe. It has been argued that analyzing the gendering and aiming at a 'de-gendering of computational artefacts' needs a careful theoretical background, in order to avoid well-known shortcomings such as essentializing gender or technology or falling into the trap of technological determinism.

Nevertheless, it requires further discussion whether the artefacts that have been developed according to the proposed methodology can, in the end, be 'better' or 'less gendered' than those developed outside of this framework. Why does design – and particularly design for de-gendering – matter? Numerous STS case studies have stressed that designers' intentions do not necessarily result in a use that was intended. Users rather adopt technologies in their own way – be it along designers' concepts and scripts or against them (see for instance Oudshoorn and Pinch, 2003). I would counter that these insights have already been included in the methodological framework – theoretically, but also by the procedure: the concept of posthumanist performativity takes into consideration that gender signification and re-signification is complex, situated, and historically continuously changing. The actual gendering processes are neither predictable, nor controllable for the future use of an artefact. Gender is as fluid and unstable as artefacts are. However, design is not arbitrary. On the contrary, it has – as Suchman (2007) and Barad (1996a, b, 1998) emphasize – 'real consequences' (see also Van der Velden and Mörtberg, 2012). On this basis, 'de-gendering computational artefacts' calls for a responsible handling of the design situation, where the use of the artefacts created is not foreseeable. Since the future use cannot be empirically researched, it takes into account those gendering mechanisms that have already been identified in earlier STS studies and aims to avoid them in future designs. However, practically speaking, the approach proposed needs empirical examination. This evaluation might result in further refinement and enhancement of the methodology. Hence, the challenge is now to work with the methodological framework of 'de-gendering computational artefacts' in order to gain more experience with it.

## REFERENCES

- Adam A (1998) *Artificial Knowing. Gender and the Thinking Machine*. London: Routledge.
- Agre P (1997) *Computation and Human Experience*. Cambridge: Cambridge University Press.
- Agre P and Chapman D (1987) Pengi: An Implementation of a Theory of Activity. *Proceedings of the Sixth National Conference on Artificial Intelligence*. Seattle, 196–201.
- Akrich M (1995) User Representations: Practices, Methods and Sociology. In: Rip A, Misa T, and Schot J (eds) *Managing Technology in Society*. London/New York: Pinter, 167–84.
- Allhutter D (2012) Mind Scripting: A Method for Deconstructive Design. *Science, Technology & Human Values* 37(6): 684–707.
- Archibald J, Emms J, Grundy F, Payne J, and Turner E (eds) (2005) *The Gender Politics of ICT*. Middlesex: Middlesex University Press.
- Barad K (1996a) Agential Realism: Feminist Interventions in Understanding Scientific Practices. In: Biagioli M (ed.) *The Science Studies Reader*. New York: Routledge, 1–11.
- Barad K (1996b) Meeting the Universe Halfway. Realism and Social Constructivism without Contradiction. In: Nelson LH and Nelson J (eds) *Feminism, Science, and the Philosophy of Science*. Dordrecht, Holland: Kluwer, 161–94.
- Barad K (1998) Getting Real: Technoscientific Practices and the Materialization of Reality. *Differences. Journal of Feminist Cultural Studies* 10(2): 87–128.
- Barad K (2003) Posthumanist Performativity. Towards an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society* 28: 801–31.
- Barad K (2007) *Meeting the Universe Halfway*. Durham & London: Duke University Press.
- Bath C (2009) *De-Gendering informatischer Artefakte. Grundlagen einer kritisch-feministischen Technikgestaltung*. Available at: <http://elib.suub.uni-bremen.de/edocs/00102741-1.pdf> (accessed 1 September 2012).
- Bath C (2010) Emotionskonzepte in der neueren Softwareagentenforschung. Von grundlegender Kritik zur feministischen Technologiegestaltung? In: Koreuber M (ed.) *Geschlechterforschung in Mathematik und Informatik*. Baden-Baden: Nomos, 187–204.

- Bath C (2013) Semantic Web and Linked Open Data: Von der Analyse zum „Diffraactive Design“. In: Bath C, Meisser H, Trinkaus S et al. (eds) *Geschlechter Interferenzen. Wissensformen – Subjektivierungsweisen – Materialisierungen*. Münster: LIT-Verlag, 69–116.
- Berg AJ (1999) A gendered socio-technical construction. The smart house. In: Wajcman J and MacKenzie D (eds) *The Social Shaping of Technology*, 2<sup>nd</sup> edn. Buckingham, UK/Philadelphia: Open University Press, 301–13.
- Bertelsen OW, Bouvin N, Krogh PG, and Kyng M (eds) (2005) *Critical Computing – Between Sense and Sensibility*. Proceedings of the 4<sup>th</sup> decennial conference on New York: ACM.
- Beyer H and Holtzblatt K (1998) *Contextual Design*. San Francisco: Morgan Kaufmann.
- Bjerknes G and Bratteteig T (1995) User participation and democracy. *Scandinavian Journal of Information Systems* 7(1): 73–98.
- Bowker G and Star SL (1999) *Sorting Things Out*. Cambridge, MA: MIT Press.
- Bühner S and Schraudner M (eds) (2006) *Gender-Aspekte in der Forschung. Wie können Gender-Aspekte in der Forschung erkannt und bewertet werden?* Karlsruhe: Fraunhofer Institut für System- und Innovationsforschung.
- Butler J (1990) *Gender Trouble: Feminism and the Subversion of Identity*. London: Routledge.
- Butler J (1993) *Bodies that matter*. New York: Routledge.
- Cassell J (2003) Genderizing HCI. In: Jacko J and Sears A (eds) *Handbook of Human-Computer Interaction*. Mahwah, NJ: Lawrence Erlbaum, 402–11.
- Cockburn C (1986) *Machinery of Dominance. Women, Men, and Technological Know How*. London: Pluto Press.
- Cockburn C and Ormrod S (1993) *Gender & Technology in the Making*. London: Sage.
- Cruzten C and Gerissen J (2000) Doubting the OBJECT world. In: Balka E and Smith R (eds) *Women, Work and Computerization*. Boston/Dordrecht/London: Kluwer, 127–36.
- Dix A, Finlay J, Abowd GD, and Beale R (1993) *Human-Computer Interaction*. New York: Prentice Hall.
- Draude C (2005) *'The agent that walked out of the display...'* Unpublished paper, Berlin.
- Faulkner W (2000) The power and the pleasure? A research agenda for “making gender stick” to engineers. *Science, Technology and Human Values* 25(1): 87–119.

- Flanagan M, Nissenbaum H, Diamond J, and Belman J (2007) A Method for Discovering Values in Digital Games. Situated Play *DiGRA '07* (Tokyo, JP September 24–28, 2007). Available at: [http://valuesatplay.org/?page\\_id=12](http://valuesatplay.org/?page_id=12) (accessed 1 September 2012).
- Friedman B and Kahn P (2003) Human Values, Ethics, and Design. In: Jacko J and Sears A (eds) *The human-computer interaction handbook*. Mahwah, NJ: Lawrence Erlbaum Associates, 1177–99.
- Gill R and Grint K (1995) *The Gender-Technology Relation. Contemporary Theory and Research. Introduction*. London/Bristol: Taylor & Francis.
- Greenbaum J and Kyng M (eds) (1991) *Design at Work. Cooperative Design of Computer Systems*. Hillsdale, NJ: Lawrence Erlbaum.
- Haraway D (1988) Situated Knowledges. The Science Question in Feminism as a Site of Discourse on the Privilege of Partial Perspective. *Feminist Studies* 14(3): 575–99.
- Haug F (1999) Erinnerungsarbeit – ein Leitfaden zur Methode. In: Haug F (ed.) *Vorlesungen zur Einführung in die Erinnerungsarbeit*. Hamburg: Argument, 199–227.
- Hofmann J (1999) Writers, texts and writing acts. In: Wajcman J and MacKenzie D (eds) *The Social Shaping of Technology*, 2<sup>nd</sup> Ed. Buckingham, UK/Philadelphia: Open University Press, 222–43.
- Kaiser A, Kuenzli E, and Nitsch C (2004) Does sex / gender influence language processing? *NeuroImage* 22, Supl.1. Abstr. No MO39.
- Lorber J (2000) Using Gender to Undo Gender. A feminist degendering movement. *Feminist Theory* 1(1): 79–95.
- Lorber J (2005) *Breaking the Bowls: Degendering and Feminist Change*. New York: W.W. Norton.
- Maass S and Rommes E (2007) Uncovering the invisible. In: Zorn I, Maass S, Rommes E et al. (eds) *Gender Designs II*. Wiesbaden: VS-Verlag, 97–108.
- Maass S, Rommes E, Schirmer C et al. (2007) Gender Research and IT Construction. Concepts for Challenging Partnership. In: Zorn I, Maass S, Rommes E et al. (eds) *Gender Designs II*. Wiesbaden: VS-Verlag, 9–32.
- McCarthy J and Wright P (2004) *Technology as Experience*. Cambridge, MA: MIT Press.
- MacKenzie D and Wajcman D (eds) (1999) *The Social Shaping of Technology*, 2<sup>nd</sup> Ed. Buckingham/Philadelphia: Open University Press.
- Marcus A (1993) Human communication issues in advanced UIs. *Communications of the ACM* 36(4): 100–109.
- Nielsen J (1994) *Usability Engineering*. San Francisco: Morgan Kaufmann.

- Oudshoorn N and Pinch T (eds) (2003) *How Users matter. The Co-Construction of Users and Technology*. Cambridge/London: MIT Press.
- Oudshoorn N, Rommes E, and Stienstra M (2004) Configuring the User as Everybody. *Science, Technology & Human Values* 29(1): 30–63.
- Preece J, Rogers Y, and Sharp H (2007) *Interaction Design: Beyond Human-Computer Interaction*. New York: John Wiley & Sons.
- Rommes E (2002) *Gender Scripts and the Internet*. Enschede: Twente University.
- Sengers P (2004) The engineering of experience. In: Blythe M, Monk A, Overbeck K et al. (eds) *Funology: From Usability to Enjoyment*. Dordrecht: Kluwer, 19–30.
- Sengers P, Boehner K, Gay G et al. (2004) Experience as interpretation. *CHI 2004 Workshop Cross-dressing and border crossing: exploring experience methods across disciplines*. Available at: [http://www.sfu.ca/~rwakary/chi2004\\_workshop/](http://www.sfu.ca/~rwakary/chi2004_workshop/) (accessed 17 February 2013).
- Sengers P, Boehner K, Shay D et al. (2005) Reflective Design. In: Bertelsen O, Bouvin N, Krogh PG et al. (eds) *Between Sense and Sensibility*. Proceedings of the 4<sup>th</sup> decennial conference on Critical Computing. New York: ACM, 49–58.
- Sherron C (2000) Constructing Common Sense. In: Balka E and Smith R (eds) *Proceedings of Women, Work and Computerization*. Boston/Dordrecht/London: Kluwer, 111–18.
- Star SL (1991) Invisible work and silenced dialogs in knowledge representation. In: Eriksson IV, Kitchenham BA, and Tijdens KG (eds) *Proceedings of Women, Work and Computerization*. Amsterdam: North-Holland, 81–92.
- Suchman (2007) *Human-Machine Reconfigurations*. Cambridge: Cambridge University Press.
- Teasley B, Leventhal L, Blumenthal B et al. (1994) Cultural diversity in user interface design. *SIGCHI Bulletin* 26(1): 36–40.
- Temm TB (2008) If You Meet the Expectations of Women, You Exceed the Expectations of Men: How Volvo Designed a Car for Women Customers and Made World Headlines. In: Schiebinger L (ed.) *Gendered Innovations in Science and Engineering*. Stanford: Stanford University Press, 131–49.
- Van der Velden M and Mörtberg C (2012) Between Need and Desire: Exploring Strategies for Gendering Design. *Science, Technology & Human Values* 37(6): 663–83.

- Van Oost E (2003) Materialized Gender: How Shavers Configure the Users' Femininity and Masculinity. Oudshoorn N and Pinch T (eds) *The Co-Construction of Users and Technology*. Cambridge, MA: MIT Press, 193–208.
- Wagner I (1993) Women's voice. The case of nursing information systems. *AI & Society* 7(4): 295–310.
- Wajcman J (1991) *Feminism confronts technology*. Cambridge, UK: Polity Press.
- Wajcman J (2007) From Women and Technology to Gendered Technoscience. *Information, Communication & Society* 10(3): 287–98.
- Weber J and Bath C (2007) 'Social' robots & 'emotional' software agents. In: Zorn I, Maass S, Rommes E et al. (eds) *Gender Designs II*. Wiesbaden: VS-Verlag, 53–64.
- Zorn I, Maass S, Rommes E et al. (2007) *Gender Designs II*. Wiesbaden: VS-Verlag.

## Masks between the Visible and the Invisible

CECILE K. M. CRUTZEN

“The world men are born into contains many things, natural and artificial, living and dead, transient and sempiternal, all of which have in common that they appear and hence are meant to be seen, heard, touched, tasted and smelled, to be perceived by sentient creatures endowed with the appropriate sense organs. Nothing could appear, the word ‘appearance’ would make no sense, if recipients of appearances did not exist – living creatures able to acknowledge and react to – in flight or desire, approval or disapproval, blame or praise – what is not merely there but appears to them and is meant for their perception.”  
(Arendt, 1978: 19)

The words ‘mask’, ‘masking’ and ‘masquerade’ are metaphors for discussing, describing, and analyzing the visible and invisible acting of human and non-human actors. The mask has for a long time been a symbol for the interpretation and representation of the visible and invisible and is a powerful device for human experience and transformation in many cultures. It still lives strongly within our societies where the mixing of reality and virtuality will continue to increase.

Masks are devices for hiding, conserving, transformation, and mediation, giving humans the protection they need. Masks have become a dualistic means of concealment and hiding but also of liberation, disclosure, and revelation. They always offer the opportunity of unmasking, disrupting the mental invis-