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Helpless machines and true loving care givers: a feminist critique of recent trends in human-robot interaction

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Kismet's design relies on the ability of people to interpret and understand the robot's behavior.
Cynthia Breazeal 2002, 119

In recent developments in Artificial Intelligence (AI) and especially in robotics we can observe a tendency towards building intelligent artefacts that are meant to be social, to have 'human social' characteristics like emotions, the ability to conduct dialogue, to learn, to develop personality, character traits, and social competencies. Care, entertainment, pet and educational robots are conceptualised as friendly, understanding partners and credible assistants which communicate 'naturally' with users, show emotions and support them in everyday life. Social robots are often designed to interact physically, affectively and socially with humans in order to learn from them. To achieve this goal, roboticists often model the human-robot interaction on early caregiver-infant interactions. In this paper I want to analyse prominent visions of these 'socio-emotional' machines as well as early prototypes and commercial products with regard to the human-machine interface. By means of this I will ask how feminist critiques of technology could be applied to the field of social robotics in which concepts like sociality or emotion are crucial elements while, at the same time, these concepts play an important role in feminist critiques of technology.

Keywords: **human-robot interaction, feminism, human social characteristics, care, entertainment**

INTRODUCTION

Over the past years we can observe profound reconfigurations at the boundaries between humans and machines in the field of artificial intelligence and especially robotics. There is an ongoing paradigm shift from machine-oriented concepts, algorithms and automats towards interaction (see Hayles, 2003; Crutzen, 2003). While early approaches sought to model rational-cognitive processes and to solve problems using formal structures, the emphasis is currently shifting to socio-emotional interaction.

While early AI focussed on symbol processing, more biologically-inspired approaches and initiatives became prominent in the late 80s and 90s which "played down the personification of machines" (Suchman, 2003a, 2). Today, we experience a shift towards socially-inspired AI and a new interest in the interaction between human and machine.

Since the mid 90s Human-Robot-Interaction (HRI) has become an important and rapidly growing field in socially-inspired AI. For a long time robotics had been a field for experts only. Industrial robots as well as professional service robots are programmable machines that didn't offer challenges to human-computer interaction. Everyday users didn't come into play. Today's personal service robots which are built to entertain, educate and/or assist people in everyday life are a big challenge in understanding how to design robots that will accomplish these goals. This is the reason why HRI is increasingly regarded as an important field and accepted by

the robotics community (see Kiesler & Hinds, 2004; Rogers & Murphy, 2004). HRI is an interdisciplinary field that lies between robotics, AI, cognitive science, (developmental) psychology, user testing, biology (esp. ethology), and partly sociology which develops concepts for interaction between everyday user and personal robots with regard to social learning and socio-emotive interaction.

1. SOCIABLE ROBOTS AND THE CAREGIVER-INFANT RELATIONSHIP

Cynthia Breazeal from the Massachusetts Institute of Technology (MIT) is one of the leading researchers in the field of social robotics. Her vision of a sociable robot is a good example that clarifies the ambitious goals of some researchers in the field of human-robot interaction:

> "For me, a sociable robot is able to communicate and interact with us, understand and even relate to us, in a personal way. It should be able to understand us and itself in social terms. We, in turn, should be able to understand it in the same social terms – to be able to relate to it and to empathize with it. Such a robot must be able to adapt and learn throughout its lifetime, incorporating shared experiences with other individuals into its understanding of self, of others, and of the relationships they share. In short, a sociable robot is socially intelligent in a human-like way, and interacting with it is like interacting with another person. At the pinnacle of achievement, they could befriend us, as we could them." (Breazeal, 2002, p. 1)

Social artefacts are supposed to become part of our daily life. Therefore the roboticists stress their goal to develop robots that will be able to adapt in a natural and intuitive manner – not vice versa. For example, Kismet is designed to interact physically, affectively and socially with humans, in order to learn from them. The man-machine-relation (or should one say the woman-machine-relation?) is modelled after early infant-caregiver interactions. For example, in her book *Designing Sociable Robots* Cynthia Breazeal explains that according to developmental psychology the

> "initial perceptual and behavioural responses bias an infant to interact with adults and encourage a caregiver to interact with and care for him. …She [The caregiver; JW] allows the infant to experiment and learn how his responses influence her. […] It is important to consider the infant's motivations – why he is motivated to use language and for what reasons. These motivations drive what he learns and why. These insights have inspired the design of Kismet's synthetic nervous system …My goal is for people to play with Kismet as they would [with; JW] an infant, thereby providing those critical interactions that are needed to develop social intelligence and to become a social actor in the human world." (Breazeal, 2002, p.37)

This concept of the caregiver-infant relationship between the user and the machine reminds me of a stereotypical mother-infant relationship in a bourgeois nuclear family, where the housewife dedicates all her time to the education of the only child and the household.

Another dominant and quite similar concept of Human-Machine relationships in recent Human-Robot interaction is that of owner and pet, where humans are supposed to engage in the training of their robo-dogs, -cats, -bears etc. (see Steels & Kaplan, 2001; Kaplan *et al.*, 2001)

The question here is whether it is desirable that people invest such a huge amount of time in educating their personal robots so that they might become (more) intelligent. In a way, it is a kind of clever outsourcing, which enrols the user in the time-consuming adaptation of the personal robot to its environment and gives her or him the feeling to develop one's own artefact. This approach obscures the roboticists' authorship in the Human-Machine relationship (see Suchman, 2003a, 7f.) and makes invisible the fact that there has been no user participation in the design and programming of the social robot.

Figure 1 Cynthia Breazeal with Kismet

The concept of the caregiver-infant-relationship and of social learning via the interaction with other humans can be found in a variety of research approaches (see Fong, 2003; Steels & Kaplan, 2001) in Human-Robot interaction, but there are also some approaches in which social robots are designed as 'adults' (see for example Bennewitz, 2004).

In order to realise this envisaged machinic social behaviour researchers use models and theories not only from the fields of (developmental) psychology, but also from cognitive science, ethology and sometimes sociology (see Burghart & Haeussling, 2005), thereby aiming at the implementation of social and emotional competencies.

1.1 The Representation and Design of Social Robots: Using Anthropomorphism, Baby Scheme and Gender

Roboticists stress the importance of the aestetics and physicality of social robots. Many roboticists refer to the work of Byron Reeves and Clifford Nass (1996) who claimed that humans have evolved the tendency to anthropomorphise computers and robots. In Reeves and Nass' experiments humans treated computers with politeness, they felt charmed by their compliments etc.. Reeves and Nass argued that in the course of evolution humans have become used to behaving socially towards others who also interact in a social manner. That is why humans treat (intelligent) agents as social beings. Humanoid robots with their similar morphology and sensing modalities are regarded as especially useful as a social interface; this is because people's mental models of autonomous robots are often more anthropomorphic than are their models of other systems. As robots are also more likely to be mobile than other intelligent agents, thereby bringing them into physical proximity with other people, it might be helpful to give them a human-like shape (see Kiesler & Hinds, 2004). Social roboticists want to exploit the assumed human tendency of anthropomorphising machines and interacting with them in a social way by shaping them either woman-like, like an infant or like a pet.

In many cases social robots are given a gendered shape. Roboticists often argue that users would be disturbed by humanoids with no clear-cut sex or gender. At the same time this is also the result of a practical necessity – because gendered speech software with either a high (female) or low (male) voice, forces roboticists to gender their robots using use 'off-the-shelf' speech software.

Another case where practical necessity forces the female gendering of a robot is Robota. Robota is a doll-shaped robot toy developed by the roboticist Aude Billard to investigate what social skills are needed for Human-Robot social interaction. According to Aude Billard, Robota is always a

Figure 3 Valerie as the domestic android (left) and as a mannequin (right)

female doll "simply because the toy market does not offer any boy doll with the required features (30 cm height minimum and rigid body)." (see Billard, 2003, 260, footnote 2). While on the one hand the 'female' dolls may support the interest of girls in robots, on the other hand, the gendering of Robota might reinforce traditional gender stereotypes not at least because of her traditional outfit (skirt, long hair, etc.) and partly because of her behaviour (one of her favourite tasks is to dress up).[1]

Another example of a gendered, and in this case, sexist design of a social robot is the "android Valerie, a domestic android" (http://www.androidworld.com /prod19.htm, July 2003), which looks like a classical femme fatal from Hollywood; the designers stated in their website that they shaped their robot as a female because people would be less afraid of it. Nevertheless, it seems that they couldn't resist endowing the domestic, futuristic house-cleaning robot with a strong, if not threatening, sex appeal. Maybe that's why they recently declared Valerie a mannequin (http://www.androidworld.com/ prod19.htm, August 2005)

In spite of the conceptualisation of the Human-Machine relation, a first glance at the prototypes and commercial social robots reveals them as not very promising from a gender perspective.

It is conspicuous that most domestic(!) social robots are female, an infant or a pet. Because it is not possible to build autonomous humanoids with the competencies of human adults, Cynthia Breazeal decided to design Kismet with "an infant-like appearance of a fanciful robotic creature. …The key set of features that evoke nurturing responses of human adults…have been explicitly incorporated into Kismet's design." (Breazeal, 2002, 51). Social roboticists make explicit use of the baby scheme to 'trigger' nurturing responses from users.

Even though some of the new social artefacts appear more 'neutral' and less gender-stereotyped (like Kismet or the robo-dog AIBO)[2], at first glance they are nevertheless modelled on questionable ontological assumptions (see also Weber, 2005). They exploit or reinforce stereotypical social relations such as mother-child (caregiver-infant) or owner-pet and trigger stereotypical behaviour with the help of the baby scheme to build social relationships between humans and machines in which users are supposed to educate the social artefacts.

The visions and realisations of social artefacts in robotics give rise to many questions: What and whose understanding of sociality and emotionality is realised in these new artefacts? Is it desirable from a critical feminist perspective to develop 'emotional' artefacts we are supposed to empathise with? Do artefacts modelled in terms of infant-caregiver-relationships represent our understanding of social behaviour? Or, more generally: is it desirable and promising to model Human-Machine relationships on the basis of those assumed to hold between humans?

But however we judge these 'social' artefacts, we have to take seriously today's researchers' dreams of a new and potent generation of socially intelligent artefacts. The implementation of sociality and emotionality into artefacts has become the centre of attention in numerous research and development projects in the field of robotics. We now have research projects and fields such as 'social robotics', 'social computing' and the like. Already thousands of personal entertainment and pet robots like the robo-dog AIBO (see Ichbiah, 2005) or the pet robot Paro for elderly-people (see Shibata *et al.*, 2005) are sold and in use – mainly in Japan, USA and Europe.

2. HOW TO CRITICISE A 'SOCIAL' TECHNOLOGY? SOCIAL ROBOTICS AND FEMINISTCRITIQUE

In the last decades feminist scholars as well as other critics pointed to the fact that researchers did not take into account the social dimension of technology. They criticised the lack of embodiment and situatedness in AI research (see e.g. Dreyfus, 1963; Suchman, 1987, 2004; Becker, 1992) as well as a limited understanding of intelligence which was often equated with the manipulation of symbols. Feminist critiques focussed on the reductionist modelling of thought, on the simple understanding of human planning and acting as a merely rational-cognitive process and on approaches to problem solving constrained by the use of formal structures (see e.g. Suchman, 1987)[3]. But in the late 1980s and 90s roboticists themselves started to question their own epistemological and ontological groundings. They asked whether abstraction and top-down approaches are the right tools for AI research.[4] Today we find growing attention in recent robotics towards the social context, the structural coupling of system and environment, embodiment, situatedness and even historicity of the artefacts. It seems as if the critique of reductionism, abstraction, disembodiment and the neglecting of the social dimensions are now recognised by roboticists (see Pfeifer & Scheier, 1999) and translated into action.[5]

Having feminist critiques in mind, I wonder why technoscientists want to anthropomorphise machines and discover sociality and emotionality as

the cure for our still unimaginative, rational-cognitive grounded machines.[6] It seems that the traditional strategies of wo/man-machine-communication are turned upside-down. While for a long time humans had to behave rationally and in a rule-oriented way to make symbol-oriented machines successful, now machines are to become social in order to increase their usability and make them more helpful to human users. It's the machine now which is supposed to mimic or even learn those abilities and characteristics which were, until recently, regarded as purely and typically human and beyond the grasp of machines.

One reason for drawing on the popular concept of sociality and emotion might be the idea that the conceptualisation of the Human-Robot relation as that of caregiver and helpless infant helps to enforce the acceptance of these machines in new realms of everyday life. Sociality and emotionality have been deeply gendered categories in western thought that have hitherto been assigned to the feminine realm. And personal service robots are supposed to work mainly in the – female engendered – private sphere.

At the same time, we find more and more female roboticists in this, still small, research field - as if their so-called 'natural' competencies of sociality, communication etc. predetermine them to work in social robotics, while there were only very few women who work in old-fashioned, symbol-oriented AI or biomimetic robotics. I guess that, for some, female roboticists social robotics might be a door into this still quite male-dominated field of AI.[7]

It is not by chance that institutes, research groups and companies represent a female and nice-looking roboticist like Cynthia Breazeal as a reliable and true loving caregiver for the helpless infant robotic creature Kismet. I guess it helps not only to model the relationship between humans and social robots that are still very limited in their abilities, it also strengthens the public interest in social robotics and helps to reduce the distrust in these machines which are supposed to be present and work in the private sphere. It might be effective to show machines as helpless and in need of support by their users to raise the acceptance of these machines - especially in the field of education, entertainment and assistance.

On the one hand, sociality is often interpreted as, and reduced to, very stereotypical interaction patterns between mother and child or owner and pet, yet at the same time, it is exploited as a seemingly 'natural' female property to educate personal service robots for the private realm. Thus, it might appear that it is the natural properties of women which support the proper education of the robot rather than the competency of the (female) roboticists.

On the other hand, robots are designed in the shape of women, infants or fancy creatures to make them appear as harmless and friendly companions and to trigger nurturing responses by their users. This understanding of sociality helps to minimise the expectations of users towards the social robots and supports at the same time a naïve, non-demanding attitude towards the machines.

3. SOCIAL MACHINES AND RULE-ORIENTED BEHAVIOUR

My impression that recent research in Human-Robot interactions aims at a naïve and non-demanding attitude on the part of users towards the machine brings a certain critique of AI to my mind. Lucy Suchman (1987), Harry Collins (1990), Bettina Heintz (1995) and others pointed out that it is not the machine which adapted to humans, but humans who adapted themselves towards the machine. For example, Bettina Heintz (1995) worked out the social and societal preconditions and implications of the mechanisation of thought and every day life through AI. She claimed that first of all it was human beings who adapted themselves to the machine. Otherwise our unimaginative machines would not work at all. For example, think of the secretaries who use very simple language thereby avoiding any ambiguities in order to enable translation software programs to work properly. The abilities we regard as genuine ones of computers are often the result of the efficient work of humans. And often we unconsciously compensate for the deficiencies of the machines, while at the same time our readiness to perceive machines as intelligent stems from our tendency to interpret our reality as loaded or even structured with meaning. (see also Collins, 1990)

To design robots as seemingly helpless infantile machines, pet robots or even artefacts which are gender-stereotyped as helpless women follows in detail this tendency to anthropomorphise and especially in its compensating for the deficiencies of machines. What else is intended by using the baby scheme to trigger nurturing responses and to model the Human-Machine relation as that of a reliable and true loving caregiver and helpless infant?

But these attempts to enrol the user in stereotypical social interactions rests at the same time on a kind of mechanisation of everyday life which must have already taken place before the computer came into this process. As Bettina Heintz pointed out,

the translation of problems into algorithms only becomes possible when humans already act in a rule-oriented manner. A standardisation of human behaviour is necessary to model and develop software applications. Following these arguments, the critique should not challenge primarily the claim that computers might become intelligent, but has to question the conditions that make us believe in the intelligence and sociality of machines. What is the background in our society that elicits rule-oriented behaviour that can be found so frequently?

Every socially intelligent machine we can dream of is still based on rule-oriented behaviour, since this is the material basis and fundamental functionality of these machines. Therefore it is rule-oriented social behaviour that is at the core of the theoretical approaches, concepts and practices of roboticists. This kind of rules might differ in diverse strands of AI, but a standardisation of human behaviour is a precondition for every computer model and software application Anthropomorphised machines are intended to operate by simulating social *norms*, supposed gender differences and other *stereotypes*. The starting point for these prototypes and implementations is rule-based social behaviour that is said to be performed by humans. Researchers often use biological, (folk) psychological and sociological concepts of sociality and emotionality to model Human-Machine relations. Those theories from the wide range of biology, psychology and sociology are specially chosen for the computational modelling that assumes that social behaviour is operational.

And it is not by accident that social robotics is working with sociological and socio-psychological approaches that explicitly use gender dichotomies and stereotypes. For example, I found a case where researchers used a feminist approach to improve the construction of credible artefacts: the computer scientist Daniel Moldt and the sociologist Christian von Scheve (2002) point out the value of roles, class and sex/gender differences in social interaction and their usefulness in minimising the contingency and in maximising the prediction of the behaviour of the alter ego – of the human or machinic partner in social interactive processes According to Moldt and von Scheve roles, class, gender and other differences are ideal categories to construct anthropomorphised agents. In the realm of human interaction it is regarded as helpful to use emotions to influence users, to direct the intentionality of others and to smooth interactions. Referring to the feminist sociologist Arlie Hochschild they claim that emotions are based on a system of values and norms. They are influencing the development and performance of emotions to match the expectations of the alter ego. Inspired by these ideas, Moldt and von Scheve strive for agents that express emotions based on this system of values and norms. They hope that this would help to make agents appear as intelligent, social and endowed with a personality (see Moldt & von Scheve, 2002).

Not all of these new approaches that aim to implement sociality into machines exploit critical theories and feminist approaches in this way. Nevertheless, this example shows that the paradigm shift from rational-cognitive to social machines does not lead to a departure from masculinist technology design. This and other models rather point to the fact that gender stereotypes are instrumentalised in order to build "better" machines that are perceived as socially intelligent.

Obviously, recent research in the field of social robotics is not primarily about making machines social as most researchers suggest. Rather it seems to be about *training humans in rule-oriented social behaviour between caregiver and infant, owner and pet, etc.*. Only relying on the latter can make the interaction with these machines intelligible: just as secretaries have to use an impoverished language to be able to use computer translation software, so too it will be necessary to use impoverished ways of social interacting – think of the baby scheme and the stereotypical mother-child relationship – to respond to these personal service robots. And while researchers use social norms and stereotypes to make their artefacts more consistent, convincing and credible, training humans in stereotypical behaviour supports ways of acting which are predictable and therefore more exploitable in economic terms.

4. DIMENSIONS OF CRITIQUE

In the following I want to summarise my critique and the strategies, tools and dimensions of feminist technoscience studies that incorporate the most recent developments in the field of Social Robotics and Human-Robot interaction.

4.1 Gender Representation

Rethinking sexist images or the strongly gender stereotyped design of social robots as women, infants or pets, it is clear that we need a critique of these stereotypes, patterns, norms and roles. This kind of critique of technology design targeting *gendered representation* is found most often and is

even shared by some (male) computer scientists. But it is not sufficient only to revise the design of technology in the sense of wiping out its explicit or implicit gender stereotypical shape. Nor it would be satisfying even to eliminate these and other social norms, roles and stereotypes like those of class, of age, of race, of sexuality etc. Gendered ontological, anthropological and epistemological claims are also encoded in theoretical concepts that form the basis for technological construction and software applications. Especially the stereotypical changing understanding of the social in general and the support of a naïve and non-demanding attitude towards the machines from the users show that we need to pay attention to further epistemological, ontological and societal dimensions of critique.

4.2 Social Theory

The relationship between 'social machines' and the standardisation of everyday life should be explored from a *social theory* perspective. The question is whether we live in a society where social relations in general or at least in specific realms are already enacted in terms of rule-oriented behaviour. Why is it that stereotypical patterns of social interaction between mother and child, owner and pet are so intriguing? Another example would be pet robots for elderly people, which are also built to trigger nurturing responses to occupy old people and to enhance (rudimentary) social relations between people, why are professional caretakers so scarce, that they cannot manage their workload, let alone facilitate social relationships between elderly people. The question here is whether the standardisation of social behaviour between the elderly people via the pet robot might not lead to even more rule-oriented and stereotypical social behaviour. This question is linked to that of whether social machines are expected to fill in personal and relational gaps that emerge with the new social and work requirements in the age of globalisation. Are personal robots that empathise with us and whom we have befriended the substitute for personal human relationships in the age of mobility and change? Which deficiencies of our social life in modern society and especially the neo-liberal economy are supposed to be 'repaired' by these artefacts? (see also Suchman, 2003b)

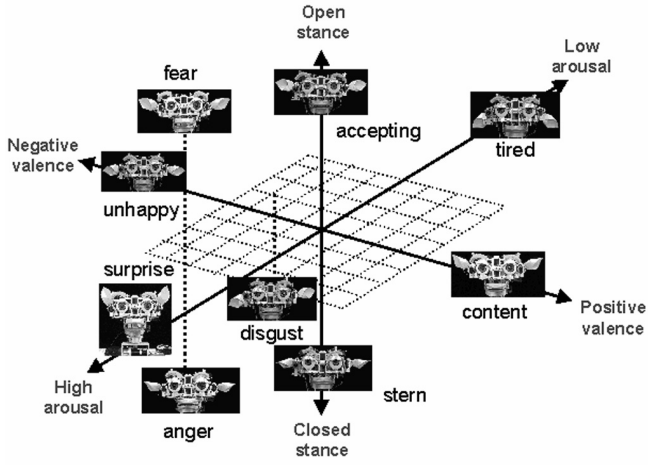

Figure 4. The facial expressions of Kismet with the six primary emotions proposed by Ekman (1992) along with three arousal states ("boredom", "interest", and "calm") at http://www.ai.mit.edu/projects/sociable/images/basis-postures-web.gif

4.3 Anthropological and Ontological Dimensions

From a critical perspective, questions of anthropological and ontological groundings arise on which technoscientific concepts in the fields of robotics and AI are built. What is the underlying understanding of society, sociality and human interaction? How is the relation of human-machine conceptualised?

We cannot only find the reduction of social interaction to stereotypical and gendered behavioural patterns between mother and child, owner and pet, but also an underlying reductionist understanding of sociality in many – especially Anglo-American – approaches of the social and behavioural sciences. Here, sociality is often interpreted in a neo-darwinist way as the outcome of the interaction of individuals, which are understood primarily as being self-interested. Thereby,

> "'social' refers to the exchange of costs and benefits in the pursuit of outcomes of purely personal value, and "society" is the aggregate of individuals in pursuit of their respective self-interests." (Carporeal, 1995, p. 1)

These (reductionist) concepts are partly translated into action by social robots and often become even more trivialised and simplified through software implementation processes. For example, in robotics human behaviour is sometimes standardised by no more than six basic emotions (see Ekman, 1992; Breazeal, 2002, 96).

Other ontological and anthropological claims of Human-Robot Interaction can easily be illustrated by the concepts of Human-Machine relations. The relationships of owner-pet, parent-baby or

caregiver-infant are each a kind of pedagogical relationship that requires a lot of time, patience, engagement and work to function properly. Are these the kind of relationships desirable for Human-Machine interaction? Do we really want to educate our machines?

FUTURE DIRECTIONS

In this paper, I have examined some of the (questionable) epistemological, ontological and anthropological assumptions of the emerging field of Human-Robot interaction. One of these assumptions is that our technologies become more complex and that the user needs to handle these technologies in a familiar way. This affordance is interpreted as the need for interfaces that resemble those of Human-Human interaction. The interfaces of new commercial applications are modelled with regard to (gender)stereotypical social relations, which rest on the anthropomorphisation and personification of machines as infantile and helpless creatures, while roboticists as well as users are modelled as caregivers. Users are manipulated (with baby schemes, etc.) to investigate time in the 'education' of their own personal service robots. Gender and other stereotypes are used to standardise the human-robot interaction, thereby reproducing and reinforcing existing stereotypical social behaviour (like nurturing, etc.). This concept of Human-Robot interaction exploits the readiness of the user to compensate for the deficiencies of machines. Humans are adapting to the machine and are investing additional work to make sense of the machinic behaviour.

This partly naturalistic and stereotyping design of the Human-Robot interaction shows the need for more self-reflexivity (Grundy, 2005), epistemological pluralism (Björkmann, 2005; Grundy, 2005) and a "critical transformative room" (Crutzen, 2005, 43) which leaves various options for modelling the design, function and use of technology. For about 20 years we have the claim of critical approaches in Human-Computer interaction to involve users in the design of technology and to evaluate their preferences and needs. And I would add that it is crucial to work out different epistemological and ontological groundings for technology design and ICT applications.

But in rethinking Human-Robot interaction from an ethical perspective, one may ask even more radical questions: Who needs robots and for which applications? What are the costs and benefits and for whom? Cui bono? Which doesn´t mean we should reduce the discussion of social robotics to only a question of costs and benefits.

It might be worthwhile to think of robots not primarily as our mirrors and substitutes. I found it quite interesting that many researchers in the field of engineering argue against naïve realism and reductionist mimicry. They state, that "to fly, we had to build a plane, and stop trying to build artificial birds!" (Duffy, 2004).

Thus, if we really want to build promising machines that might be worth the effort and expense, we should think of artefacts that are beyond helpless, nurture-triggering creatures.

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NOTES

1. Another question is whether the well-known Autonomous System Laboratory at the University of Lausanne (ELPF) with their well-stocked research funds could afford to build their own boy doll.
2. See http://www.eu.aibo.com/
3. See (Adam, 1998) for an overview of feminist critiques of AI.
4. See Brooks (1986), Pfeifer and Scheier (1999).
5. For a discussion philosophical and feminist influences on AI see, for example, Sengers (1999).
6. While roboticists often point towards the tendency of anthropomorphism in the human-robot interaction (Duffy, 2003; Fong, Nourbakhsh & Dautenhahn, 2003), they rarely reflect on the additional work of humans to make sense of machinic behaviour (see e. g. Suchman, 2004 on the relationship between Breazeal and Kismet).
7. I undertook some interviews with social roboticists as part of the research project "Sociality with Machines. Anthropomorphizing and Gendering in Recent Software Agent Research and Robotics" at the Institute for Philosophy of Science at the University of Vienna (www.univie.ac.at/soziale_maschinen). In one of the interviews a roboticist mentioned this possibility.

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