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GENDER EQUALITY IN ENGINEERING THROUGH COMMUNICATION AND COMMITMENT

(GEECCO)

Review

Literature Review: Gender and Robotics

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Contents

1 Introduction

> I'm for more women in robotics, not for more female robots.[1]
> - Martina Mara (2017)

Therobopsychologist Martina Mara made this statement during an interview and similar comments are not hard to find in many technological fields. And although it is a pressing issue, this review deals instead with the second part of Mara's statement, or rather, with its consequences: the female robots. To be precise, the aim of this review is not to present female robots, but to tackle the topic of robots, and especially gendered robots from different, however mainly feminist or gender-sensitive perspectives, since these perspectives are mostly sidelined in the technical literature. This report aims to highlight the most relevant discourses on the topic of gender and robots. In order to sensitize readers, I would like to quickly mention that when following Butler (cf. 2006) or taking Queer Theory into consideration, sex and gender are socially constructed. Furthermore, it is necessary to mention that not merely two or three gender identities exist, but rather, many more.

1.1 Definitions and Demarcations: Robots and Non-Robots

This literature review deals exclusively with the artifact "Robot", which the IEEE (In- stitute of Electrical and Electronics Engineers) defines as follows:
A robot is an autonomous machine capable of sensing its environment, car- rying out computations to make decisions, and performing actions in the real world.("What Is a Robot?", 2019)

The IEEE further highlights the non-triviality of such a definition, since what is or isn't a robot, is not always uniquely definable, even for roboticists. To offer a further defi- nition, I would like to present Janina Loh's (2019). Loh is a philosopher of technology, working among other things on robot ethics. For her work, she defines a robot as follows:

> I define a robot as an electro-mechanical machine with a) a body, b) a pro- cessor, c) sensors, that collect data, d) and an effector or actuator, that translates signals into mostly mechanical operations. The robots behaviour
> e) is or at least appears to a certain degree autonomous. It can, therefore,
> act on the environment in a way that computers cannot. (Loh, 2019)

[1] https://ars.electronica.art/aeblog/en/2017/03/08/women-robotics/

While, most aspects overlap with the definition presented by the IEEE, she adds that the appearance of autonomy suffices for her analysis. This (appearance of) autonomy is a very relevant factor in social robotics or ethics and the accompanying issue of deception, which is often revisited in the analysis of care robots in a surrounding where children or those suffering from dementia could potentially be “deceived” by the robot.
Robots are mostly “equipped” with what is often called an artificial intelligence or the ability to “learn”, e.g. via machine learning algorithms. Many people from the field also claim that in order to be considered a robot, it must have some kind of “artificial intelligence”.

Given these comprehensive definitions, I would like to narrow the subject of the cur- rent review. Gender bias is a frequently discussed topic in literature surrounding the field of Critical Algorithm Studies. Due to unbalanced training data, sexist and racist outcomes can be seen in many cases (cf. Noble, 2018; Allhutter, 2018). An example for such bias, which raised awareness in 2016, was that the google image search for the terms “unprofessional hairstyle” resulted in images of black women (Alexander, 2016). Three years later, when searching these terms, one finds references to this story instead. How- ever, when I google “professional hairstyles” today (2019), the results show primarily white men.
In addition, I want to distinguish my topic from adjacent fields or technologies, which would also be intriguing to scrutinize further, such as virtual assistance or AI. The UNESCO [2]published a program and meeting document concerning these topics, which is openly available.
Another figure, which is not a robot, but still important to mention, is the cyborg (= cybernetic organism). In many ways it is distinct from a robot, and moreover, an android, which is a robot resembling a human. I understand cyborg as a somewhat altered human (potentially also animal or plant), enhanced with technologies. To further elaborate on this, one would have to consult literature dealing with post- and transhumanism (cf. Loh, 2018). Also, the question concerning “the gender” of a cyborg is profoundly different than the question about “the gender” of a robot. Aside from what Donna Haraway (1991) claims - namely that a cyborg lives in a post-gender world - a cyborg is able, in contrast to a robot, to self-identify as a certain gender (or not).

[2] https://unesdoc.unesco.org/ark:/48223/pf0000367416

1.2 Queering Gender and Sex

To begin with, there is no unique definition for sex and gender, or for their intertwining or distinction. Different views can be identified concerning this topic. For the purpose of this review, we define sex as the biological dimension of a human body, where sex char- acteristics are present that are considered as male, female, or intersex. Gender is defined as the norms and expectations that relate to its expression in behaviour, gestures, lan- guage, feelings, and physique. Gender thus refers to (stereotypical) characteristics that are tied to social expectations regarding adequate and inadequate behaviours, attitudes and preferences. The term gender (often described as a reference to cultural attitudes and behaviours) as opposed to sex (mostly refers to biological characteristics), gained popularity from the 1960s onwards as an opposition to biological deterministic views on the biological sex. However, while it is said that sex and gender mutually shape one another and gender is mostly seen as socially constructed, Judith Butler (cf. 1990) takes the assumption one step further and claims that both sex and gender are socially con- structed. She cites Simone de Beauvoir, who said “One is not born, but rather becomes, a woman”.
Literature in the field of Human-Robot Interaction often does not distinguish between the terms “sex” and “gender”, but instead uses them interchangeably, with what seems to be a preference for the term gender. Beyond this lack of reflection on gender and sex, the categories of “female” and “male” seem set in stone, even for robots in some instances, while neglected is that many more gender identities are present and should be included.

1.3 Sensitizing Concepts

This section will present important literature from the umbrella term “feminist techno- science”, which deals with human-robot interaction and promises of technology.

1.3.1 Drawing Together Feminism and Technoscience: Donna Haraway’s Cyborg Manifesto

Although this literature review deals with robots - not cyborgs, Donna Haraway’s (1991) Cyborg Manifesto was a pioneering work in feminist technoscience, which serves as a beneficial basis for thinking about feminist issues in robotics, since it sheds light on the intersections between human and machine. With her trope of the cyborg, Haraway aims to recognize the blurring of boundaries, such as “male/female” (ibid., p. 177), animal/machine, or human/machine. Distancing herself from technological deterministic.

views (i.e. that technological change implies socio-cultural change), Haraway imagines a post-gender world due to dissolving boundaries. To date, this does not hold true, as parts of the literature review suggest. However, keeping the “promise” of the cyborg and its emancipatory character in mind could foster sensitivity in the design of technologies when it comes to gendered aspects, and a reproduction of stereotypes.

1.3.2 Drawing Together Feminism and Technoscience: Lucy Suchman's Human Machine Reconfigurations

Lucy Suchman, an anthropologist of science and technology, has focused her work on critically engaging with "projects aimed at constructing computational machines as sen- tient others" (Suchman, 2006) since the late 1970s. What makes her work interesting for this literature review, is her analysis of the creation of human-like machines. While roboticists often see robots as models of the human, Lucy Suchman wants to see, what is imagined as human through the eyes of roboticists. In her chapter on "Figuring the Human in AI and Robotics" (Suchman, 2006), she reflects on the main characteristics implemented into machines in order to create something human-like. Key attributes Suchman identified are: Embodiment, Emotion, and Sociability. Famous examples for the latter were Cog and Kismet[3], located in the MIT's Artificial Intelligence Laboratory. At a talk in 2006 at the IEEE, Suchman highlights the need for demystification. She underlines this need by contrasting representations of these robots with actual encounters in the lab. While Kismet's videos on the website promise authentic interactions between Kismet and its principal creator Cynthia Breazeal, Kismet was much more unreliable when visiting it in the lab. "These re-enactments thereby imply that thecapacities they record have an ongoing existence; that they are themselves robust and repeatable, and that like any other living creature Cog and Kismet's agencies are continuing to develop and unfold." (ibid., p. 653)

1.3.3 Caring about Robots: Jutta Weber's Helpless Machines and True loving Caregivers

For Jutta Weber (2005) - whose analysis remains up-to-date - Human-Robot-Interaction is a field with increasing popularity, "An interdisciplinary field that lies between robotics, AI, cognitive science, (developmental) psychology, user testing, biology (esp. ethology), and partly sociology" (ibid., p. 210). In contrast to earlier accomplishments in robotics and AI, which can be allocated to rather rigid, rule-oriented, symbol-oriented yielding to an adaptive human behavior towards the machine, recent trends are moving towards social robotics. Social robotics is seen as a solution to increasing complexity, yielding an easier and more intuitive user interface. Problems demarcated by Weber are located on the one hand in gender stereotypes, which become embedded in the robots, as will be discussed in the next chapters, and on the other hand in typical relations presented in Human-Robot-Interaction. Jutta Weber's analysis showed that when it comes to sociable robots, two kinds of relations are predominant, namely the "caregiver-infant relationship" and the "owner-pet relationship". When moving this analysis to current discourses of sociable robots, a third category might arise, when thinking about sex- robots and the thereby implied relationship.

[3] http://www.ai.mit.edu/projects/sociable/baby-bits.html

> 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 be- come (more) intelligent. In a way, it is a kind of clever outsourcing, which enrolls the user in the time-consuming adaption of the personal robot to its environment and gives her or him the feeling to develop one's own artifact. (ibid., p. 210)

This quote is especially interesting, since it makes visible the tension between the involvement and exclusion of users. The former was often demanded by feminists in technoscience. Weber claims that "Social roboticists want to exploit the assumed hu- man 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." (ibid., p. 211) This is very much in line with literature suggesting that e.g., a "male" robot might seem threatening in the domestic environment (Carpenter, 2009). For that reason it seems logical, that roboticists make use of the so-called Baby Scheme, meant to trigger nur- turing responses from the user.

The reason for presenting these works at this stage of the review is, to emphasize the blurring of boundaries, the conceptualization of what is human and how this humanity is imagined in building humanoid social robots and relations between humans and robots.

1.4 Excursion: Media Equation Theory

Although this theory is not highlighted in feminist or gender-sensitive literature, it ap- pears to be prevalent in papers dealing with Human-Robot-Interaction (HRI), since it makes a strong claim about our interaction with machines. In this section, the theory

will be outlined briefly and links to relevancies in dealing with robots from a feminist perspective will be displayed. This popular theory was co-created by Byron Reeves and Clifford Nass, both professors of communication science. Basically, they claim that "We respond to communication media, media technologies, and mediated images as we do to actual people and places" (Littlejohn & Foss, 2009, p. 635). To prove this hypothesis, the scholars looked at existing work in the field of psychology dealing with Human-Human- Interaction and substituted one of the humans with a media artifact. Interestingly, they arrived at similar results. One example would be that manners, including politeness, arises in a similar way when confronted with a computer or a human being. Test sub- jects were meant to solve a problem with a computer and later evaluate the capability of the device. Those who did the evaluation on the same computer on which they had solved the problem evaluated it better than those who did the evaluation on a different PC. Dozens of studies were able to replicate similar results in the 1980s and 1990s. In line with the aim of this review, also gender was an issue in some of these studies, since although the devices do not have an actual sex or gender, people were reacting to gender cues according to prevalent stereotypes.
The theory is often summarized as media = real life. I claim, however, that the conducted studies might not prove this equation, but rather, the implication real life -> media. The other direction might be the more crucial one, for the endeavor of this review. Here, the question

arises of whether the stereotyped robots, as will be presented later, and the interaction with them, will influence human-human interaction, too. For example, when thinking about care robots or sex robots.

2 Gender & Robots

A great amount of literature deals with the topic of **Gender in Robotics** in a rather uncritical way at least when the intention is to consider the topic from a gender or feminist theory perspective, as study designs often reproduce heteronormative, binary gender stereotypes. When going through the literature, thisperspective seems inevitable. As Jennifer Robertson (cf. 2010, p. 5) correctly points out, most of the literature that can be found when looking explicitly for gender AND robots are studies dealing with **Human-Robot-Interaction**, more precisely A) the interaction of people towards feminine versus masculine robots; B) differences in the interaction of females versus males towards robots; or a hybrid of those two. Although her observations are more then ten years old, things look similar today. However, I would like to highlight a further strand of literature, coming from different fields such as **Gender Studies, Culture Studies, Science and Technology Studies**, and so forth investigating the issue on hand from a perspective that goes beyond the findings from strands A & B and looks at implications for society and coping mechanisms. In this chapter, I want to give an overview of the mentioned strands of literature, beginning with the more technical ones, to continue with the societal perspectives and end with suggested solutions, as can be found in Londa Schiebinger's recent report.

2.1 Humans interacting with Robots and Robots interacting with Humans

In the following, I reflect on sensitivities, implications and consequences of research that is not aware of broader societal and in the case of this literature review, gender specific issues. It is obvious that the roboticist is the expert when it comes to robots and building them. This does not mean, however, that they have enough expertise to gender a robot. Therefore, collaboration between the different experts must be encouraged.
Tatsuya Nomura (2017) provided an overview as well as a classification, on how gender is reflected on and used as a category in HRI. For this, he consulted literature from the field of Human-Robot-Interaction and clustered as well described it. Similar to my outline in the introduction, he found the following categories and subcategories:

i) Robot Gender: This means looking at the implication of male vs. female (or neutrally) gendered robots on the users acceptance of them. A further category of gendering robots for the author is so-called "simple gendering" (ibid., p.18), which means assigning a gender only by name-giving and voice.
ii) Human Gender: This strand of literature investigates the acceptance of robots depending on the gender of the user.

iii) Interaction Effects: They can be manifold, such as using both the “robot gen- der” and the “human gender” as a parameter, or adding other factors such as age, socio-economic status, or situational factors.

In each section, Nomura presents current research done in the field of HRI and dis- cusses the results. These results most frequently reproduce existing gender-stereotypes, especially when it comes to “typically male” vs. “typically female” tasks. This experi- mental setup should itself be viewed critically. In other cases, researchers were able to find a so-called “cross-gender effect” (ibid., p. 22), which means that female participants preferred the ”masculine” robot, whereas male participants preferred the”feminine” one. Examples for this are “masculine” security robots and “feminine” domestic robots. Most of the literature presented does not reflect on the perpetuation of gender stereotypes in their study design. Although the author reflects on the necessity of focusing on differ- ent cultures, he draws the problematic reasoning from his literature review that “When considering robotics applications in a specific area, one should also focus on cultural influences to maintain gender stereotypes related to that area” (ibid., p. 23). Towards the end of the article, the author raises ethical issues of gendered robots and outlines:

In future research, there should be a focus on gender stereotypes, cultural influences, and robotic applications in various fields. At the same time, it should be considered whether gendering of robots for given roles is truly necessary to encourage interactions between humans and robots. (Nomura, 2017, p. 23)

While seeing the potential in utilizing gender stereotypes in robotics for enhancing acceptance of users, the author also reflects on whether gendering is “truly necessary”. He points to ethical issues, such as the reinforcement of gender stereotypes through gendered robots.

2.1.1 An Abstract Portrayal and a Tangible Alternative

It appears that a lot of literature and research deals with gender aspects in human- robot-interaction. As described earlier, it mostly deals with differences in acceptance of “male” and “female” robots, whatever this should mean, or the acceptance of “males” and “females” of robots. These words are put in quotation marks to show, first, the degree of absurdity when saying that a robot is male or female, and second, that the literature works, for the most parts, within a gender binary.

In this section, I will describe what these setups typically look like and then critically reflect on them. To be blunt, researchers often form two to three groups for robots or at least “male”, “female”, and sometimes gender neutral voices. The robots then per- formdifferent tasks, which are also sometimes assigned a specific gendered connotation. After the robot’s performance, it is evaluated as to which scenario the robot appeared “more competent” or was more accepted. Sometimes these experiments reproduce gen- der stereotypes, sometimes they don’t, but in most cases it ends at that point, without much reflection.

Besides the need for reflection on the results of the study, a proper reflection is neces- sary at the beginning, when the study setup is constructed. Reducing the test subjects to their sex or gender leads to an overemphasis on sex or gender differences, while many other parameters,

such as age, socioeconomicstatus, experience, etc. might be neglected. Depending on the study, however, a further variable such as age might be taken into consideration, e.g. when doing studies concerning care robots. Döring (2013) queries if and how sex or gender should be sampled in questionnaires and takes Survey- and Measurement- as well as Gender- and Queer Theory into consideration.
Another topic, in my view, is the reflection on the results. I wonder, if gender stereo- types manifest themselves in the results, one could think ahead and break with these stereotypes rather than reproduce them.

2.1.2 Alternatives

Florian Dufour and C´eline Ehrwein Nihan (2016) in their article, “Do Robots Need to Be Stereotyped? Technical Characteristics as a Moderator of Gender Stereotyping”, tackle the question of whether robots need to be gendered, and therefore stereotyped in order to increase acceptance and the economic value of the machine. Instead of letting the “gendered look” or “fitting voice” suggest, what the robot is capable of doing, they decided to acknowledge technical characteristics in order to anchor the judgment of the users.
Although, the authors claim that further research is needed, their preliminary find- ings showed that “the effect of human stereotypes on the judgments of robots is not inevitable” (ibid., p. 8), since participants also evaluate the robot by the given technical characteristics. With their research, they strive for “giving designers of robots the choice between building stereotyped robots and building robots that avoid the perpetuation of human stereotypes, without impacting their potential economic value” (ibid. p. 8).

2.1.3 Gender Studies in HRI

The work of Yan Wang and James Young (2014) focuses on the differences in the in- teraction of women versus men towards robots, or further differences in the perspective towards robots. The authors raise the issue, that there is an underrepresentation of women in science and engineering, and in addition, women are partly overlooked as participants in HRI studies. This often leads to over-simplifications and dichotomies, when it comes to outlining the respective attitudes. Wang and Young advocate a higher gender sensitivity in order to achieve more highly nuanced results, in contrast to the “common ‘pink’ versus ‘blue’ simplifications” (ibid., p. 1).
In 2015, Rea, Wang and Young performed a further study dealing with gender in HRI, testing if they could replicate or falsify stereotypes that resulted from other studies. This worked out partly, while the stereotype that male participants are ruder towards robots than female participants held true, other stereotypes such as lower engagement of women with robots/technologies and their lack of a relaxed manner were disproven. However, their sample size was rather small and factors beside the participants’ gender were com- pletely neglected.

2.2 Robots in/and Society

Scholars from several fields, such as Cultural Studies, Studies of Technology and Society, Anthropology, History of Science, and Gender Studies, deal with the issue of robotics from a feminist or gender-sensitive perspective. Literature dealing with the topic theo- retically, as well as empirical research could be found.

2.2.1 Learning from Reviews

Starting off with a quote from the movie Her, Alesich and Rigby (2017) aim to un- derstand the implications of gendered robots for "our humanoid future". Although the effect of the gendered robots cannot yet be observed due to the lack of an actual "roll- out of robots", the authors argue that "assigning gender to robots will challenge and transform social and cultural understandings of gender" (ibid., p. 50). They first out- line that "Gendering humanoid robots will also change our social and cultural ideas of gender in human bodies." (ibid, p. 58) This assignment of gender to robots, they argue, promotes the idea that "gender is an assignation, a set of attributes" (ibid.). Since the gender of a robot can eventually be changed fairly easy, the authors conclude that "we may start to question why human gender is fixed. This would challenge dominant social norms about the immutability of human gender, which could lead to a greater fluidity of gender, as argued by cyberfeminists" (ibid.). While this is certainly an interesting idea, it is a slightly techno-deteriminist one, which might need to be reflected on more thoroughly.

Anne Cranny-Francis's (2016) article gives a more nuanced overview of the issue of stereotyped and gendered social robots. She highlights the complex entanglements re- sulting from intimacy in human-robot interaction from a Gender Studies perspective. Intimacy, however, is not only an issue for humanoid social robots, as Cranny-Francis nicely shows with the case of Roomba, the vacuum cleaning robot, as studied by Maja Mataric. Mataric found that families owning a Roomba tend to have it repaired rather than replaced, since Roomba becomes part of the family somehow. In addition to prob- lematic aspects of this intimacy, this case would also be interesting in terms of thinking about repair versus discard.

2.2.2 Peeking into Japan

An early and very comprehensive study was done by Jennifer Robertson in Japanese robotic laboratories. The anthropologist and art historian, who is also a former director of programs on Japanese Studies and Science and Technology Studies as well as professor of Women's Studies, went to Japan to understand how the Japanese culture is entan- gled with robots, she thereby also raises gender(ed) issues. For her research, Robertson went to different robotics laboratories in Japan to talk to the mostly (99 percent as she describes it) male roboticists. Most of her work is clearly situated in Japanese cul- ture, however, it yields interesting insights for a "Western robot future" - to use the terms of popular media and policy makers. But before sketching out the generalities, I want to describe some specificities holding true for the Japanese context. In her article "Robo Sapiens Japanicus: Humanoid Robots and the

Posthuman Family" Robertson (2007) investigates how "robot technologies are being deployed to reify old or 'tradi- tional' values, such as the patriarchal extended family and socio-political conservatism" (ibid., p.369). The robotic industry in Japan serves as an especially interesting exam- ple, since (humanoid) robots are deployed not only in huge factories but in the service- and (public) care sectors as well as for unpaid reproductive labor, for example in the domestic sphere. Back in 2007, Japan accounted for almost 52 percent of the global share of operable robots and was/is facing societal as well as demographic challenges, as it is framed. Birthrates are continuously sinking and the society is aging. Women are portrayed as less likely to engage in marriage and stay at home. The question arises, who will look after the senior citizens in the future? Since Japan has a rather restricted immigration policy and a low acceptance, which seems also rooted in Japan's history, the technological deterministic solution of these problems are robots, as shown by Jennifer Robertson. Looking to and writing about other parts of the world, cultures, etc., often holds the risk of normative assumptions or stigmatization. The author, however, situates the issue at hand very carefully within the broader historical, philosophical, pop-cultural and societal contexts. This was done by referring to Nishida Kitaro on the one hand, who is seen as the founder of modern Japanese philosophy and his theory of Ba (which "encompasses a non-dualistic concrete logic meant to overcome the inadequacy of the subject-object distinction" (ibid., p. 379)) and on the other hand, Shinto, as described in her latter article "Gendering Humanoid Robots: Robo-Sexism in Japan" (Robertson, 2010). Shinto is described by Robertson as follows:

> The native animistic beliefs about life and death. It differs from the three major monotheisms (that have never had a home in Japan) in that it lacks compex metaphysical and theological theories. Shinto is primary concerned with notions of purity and pollution. Vital energies or forces called kami are present in all aspects of the world and universe; some kami are cosmic and others infuse trees, streams, rocks, insects, animals and humans, as well as human creations, such as dolls, cars and robots. (Robertson, 2010, p. 12, emphasis in original).

Shinto is often said to be the reason for the high acceptance of (humanoid) robots in Japan, besides the long history of pop-cultural phenomena, such as the so-called Astroboy. But where can we find the various gendered aspects in Robertsons work? First of all, it should be seen as problematic that the aspirations of bringing humanoid robots into the households are not to be deliberated from the gendered connotations of reproductive labor in the household but in order to make the traditional family model more attractive to women, and thereby encourage them to embrace marriage. The household robot is therefore seen as a support for women. The traditional household, as described by Robertson, consists of three generations living together, in contrast to a typical nuclear family. An illustrative example of how the future should look is a comic done in order to promote the Innovation 25, a "visionary blueprint for remaking Japanese society by 2025" (Robertson, 2007, p. 169), portraying the Inobe Family (cf. ibid, p. 387ff) - a "traditional" Japanese family with a robot that is able to perform household chores and take care of the children and is seen as a member of the family. The mother, who is portrayed as having the closest relationship to the robot, should not be freed from household

chores so that she can do whatever she wants, but to be more prone to getting pregnant and serving as a “birthing machine” (ibid., p. 388).
Robertson’s article “Gendering Humanoid Robots: Robo-Sexism in Japan” (2010), as mentioned earlier, deals with further aspects worthy of looking at from a gender perspective. Her initial research questions are “How do robots embody ideas and notions of the relationship in humans between sex, gender and sexuality; and how do (the mostly male) roboticists design and attribute the female or male gender of humanoid robots?” (ibid., p. 2) In short, her answer would be that what the primarily male roboticists “take for granted in their own gendered socialization and quotidian lives is reproduced and reified in the robots they design and in their publications.” (ibid., p. 4) This can then lead to creating or moreover even sustaining “the facticity of their own world” (ibid.,
p. 4). Robertson therefore misses reflection as well as critical thinking, in order to not reinforcegender stereotypesin a posthuman sexism. An example forhumanoid gendered robots is the work of Ishiguro, who built robotic clones. He started with a replica of his

daughter, who got scared of her “clone”, then built a robotic clone of himself and further tried to build a replicate of “the average Japanese women”, who was implemented with a high pitched voice and dressed in an “I <3 Hello Kitty” shirt and a black mini-skirt. While robots were initially designed gender neutral or male, design trends have now moved to female robots which are often referred to as “fembots”. “Tomotaka Takahashi, a leading robot designer and founder of Robo Garage, predicts that over half all future humanoids will be female.” (ibid., p. 18f) And this although roboticists had “technical difficulties” in building female robots, since they claimed that the servo motor needs to be interiorized and the body should be more slender than in a male robot. These assumptions about what a “female” robot needs to look like, and the “struggles” roboti- cists had to face in building one are intriguing, since it says a lot about the imaginations
of what a (female) robot has to look like.
Robertson also brought up tensions, such as when human interaction is needed and when a robot is sufficient and for which tasks. While roboticists build robots for care- work, which is deemed highly social at least in Western countries, Robertson was derided when asking about the automation of the job of the so-called “elevator girl” or other receptionists following rather mechanical conversational patterns.

2.2.3 Grasping a “Mechanical Gender”

Roger Andre Søraa (2017) a scholar working in a department of interdisciplinary studies of culture and center for technology and society tried to introduce a ”mechanical gender” in contrast to biological (often declared as sex) and psychological (often declared as gender). In this case, the author proposes to add the mechanical gender to the critically regarded (e.g. Judith Butler) dichotomy of sex and gender. Therewith, the “mechanical gender” is reserved for technological artifacts, such as robots, and moreover for cyborgs. In his articles he sheds light on the issue of the proposed mechanical gender from various angles, such as linguistic acts, (non-)gendered humanoid robots, sex robots, zoomorphic robots, and the assumptions

of users and designers. The linkbetween the “gender” of the robot and the “talking about the robot” becomes prevalent in some of the presented cases, e.g., in zoomorphic robots and in the users. Names are often loaded with meanings, in everyday life many people would claim that a name raises expecta- tions about the gender of the person (or animal) in question. The same became visible with zoomorphic robots, such as PARO or AIBO, without being equipped with gendered features, their name lead to gendering them and giving them pronouns such as he and she. Søraa also highlighted linguistic discrepancies in different languages, e.g., English, Japanese and German. While personal pronouns are very frequently used in languages such as English (you, he, she, it...) and German, this is not the case in Japanese. The author presents the following example as illustration:

> Whilst this may work for a while, it would sound strange to Western ears to say: “Pepper is home now, and Pepper is reading a book to ASIMO. ASIMO is enjoying Pepper’s tale.” Normally, one would replace names with pronouns. A second option would be to use gendered pronouns such as “he” or “she”: “Pepper is home now. She is reading a book to ASIMO. He is enjoying her tale.“ This puts the speaker in the position of having to choose the gender of said robots. There are ways to overcome this, though, with genderless pronouns, such as “it”, which would make the robot more of a thing than a being, but effectively would save the speaker from having to gender it: “Pepper is home now, it is reading a book”. (Søraa, 2017, p. 104)

The author also points out, that when asking the Japanese roboticists about the gender of a certain robot, e.g. Pepper, they would often answer, that any gender is fine. This also resulted in a variation of outfits for the robot, from dress to suit. While staying with “it” appears as a useful position for now, things get difficult when robots are so clearly gendered as Sophia[4] or sex robots, such as Harmony[5]. However, Søraa also problematizes the “Tabula-rasa state” (ibid. p. 103). Which means that sometimes robots are claimed to be designed to not fulfill any gender stereotypes, to be designed “neutral”. Nevertheless, and this seems in line with Robertson, they can’t get rid of their hidden assumptions and projections towards the designed robots.
The author explains, that the way we gender robots will most probably affect their “personality” (ibid., p. 111) and their area of usage. He also wonders, if they should be gendered at all, which is also contemplated by Londa Schiebinger (2018).

[4] Sophia is a robot created by Hanson Robotics, modeled partly after Audrey Hepburn and Hanson’s wife. (https://www.hansonrobotics.com/) It gained popularity due to its human-like appearance and was present a lot in the media, since it received the Saudi Arabian citizenship (as a marketing gag) (Reynolds, 2018).

[5] Harmony is a “sexrobot” from realdoll. I used quotation marks, because in the case of realdolls, sexrobot means that they have bodies of sexdolls, while they have attachable heads equipped with an AI, capable of conversation controlled via a smartphone application

2.2.4 Gendering and Degendering Robots: Potential "Solutions"

Londa Schiebinger (2018) explains that robots are designed in a world, where gender norms, gender identities and gender relation are predominant. I would also argue that the whole depate about sex robots would look different in a non-patriarchal society, but since this is not about to change too quickly, this is the context in which those discussions must be held. As mentioned earlier, e.g. when talking about Søraa (2017), humans tend to gender machines and Schiebinger reminds us that gender and class are primary social categories (in social science research, for example). Nevertheless, she sstates a warning that "as soon as gender is assigned, stereotypes follow" (ibid., p. 18) yielding an amplification of stereotypes.
To deal with the situation, Schiebinger raises the following challenge for designers:

> The challenge for designers is: 1) to understand how gender becomes em- bodied in robots; 2) to design robots that promote social equality. Robots provide new opportunities to create more equitable gender norms. How can we best design both efficient and socially-responsible robots? (ibid., p. 19)

My question[6] would then be, whether they would do it, and how? Or better, why? So Londa Schiebinger looked at how gender is embodied in robots. Partly based on the robot Pepper, she formulated five criteria that appear to assign gender to robots.

> **Voice**: For Schiebinger, voice is the primary signifier of gender. She claims, that "voices are full of cultural information" (ibid., p. 19), depending of the pitch one might recognize the voice as male, female or child. While, a lower voice may signify more authority in Western countries, a childish voice is perceived as less threatening. Therefore, depending on the case, a different voice might be implemented into the robot, yielding different sets of stereotypes.

> **Name**: This category appears partly self-descriptive, however leaves some room for discussion. In the case of Pepper, Schiebinger argues that it is "nicely non- gendered" (ibid. p. 19). Additionally, the relation of name to voice might also play an interesting role, since this could break with stereotypes. Furthermore, name is a good example for something which is "put onto" a person, when thinking about directive speech acts.

> **Anatomy**: In the case of humanoid robots, features can be found that are used to givetherobot a male or female appearance. Schiebingerfinds Pepper confusingdue to its bold head, clinched waist and skirt-like legs. However, shortly after Pepper was put on the market, an online store popped up, selling clothes, wigs and sticker make-up for the robot. While, there were clothes for all genders, interestingly butler-like clothing sold the best. This

[6] Parts of this chapter overlap with an essay done in the Seminar Philosophy of Technology and Performance held by Mark Coeckelbergh at the University of Vienna in the winter term 2018

is interesting since it suggests something about the relations between humans and robots, moreover, the power-relations.

Color: “Researchers have shown that a few gender ‘cues’, lead people to assign gender to a robot. One human-robot interaction group found that a man’s black hat or woman’s pink earmuffs were enough for users to perceive a robot as male or female. Interestingly, when no cues were present, users tend to perceive the robot as male (maybe because in many languages, German for example, the word ‘Roboter’ is masculine; Western culture has a masculine default. Color is also an issue for ethnicity. Most robots - plastic or otherwise - are white, which places the robot culturally.” (Schiebinger, 2018, p. 19f)

Character: Robots can be programmed to be polite and playful, such as Pepper, or to be “sassy and demure” (ibid.) such as Siri. Since human “harassment” towards those virtual assistants emerged, developers made Siri’s answers more assertive and less polite when being insulted. This is important, since how humans treat machines might influence how humans treat each other.

Londa Schiebinger highlights, that “Gender assignment triggers gender stereotypes and evokes expectations for robot-human interactions.” (ibid., p. 21) Therefore, Schiebinger promotes **six options for reaching a greater gender equality in robots** (ibid., p. 58):

1. **Challenge current gender stereotypes**: An example for this is Valkyrie, a rescue robot built by engineers at NASA. While robots in this field (security, rescue) are often gendered “masculine”, as described in the respective section, Valkyrie is intentionally gendered “feminine”. The designer claims, that he wanted to inspire his seven-year-old daughter.
2. **Design customizable robots, where users choose features**: Here, Schiebinger, mainly highlights robots that aside from being customizable, are able to be am- biguous due to a potential mix of gender cues. (e.g. Savioke’s Botlr)
3. **Design “genderless” robots**: When sticking with humanoid robots, this is rather complex, since humans often try to assign a gender to things, that are human-like. Studies suggest, that robots without gender cues are often imagined male. (Søraa, 2017)
4. **Design gender fluid robots**: Schiebinger explains that there haven’t been ex- periments on this yet, at least none that she has heard of.
5. **Step out of human social relations**: Avoiding human stereotypes seems most feasible when the robots are not humanoid, such as RIBA-II, which looks like a giant Teddy Bear.
6. **Design “robot specific” identities**, that bypass social stereotypes

While these options are sound, the realization is difficult, not only due to the economic drawbacks for the companies, but also due to hidden assumptions of designers and users, for example, as outlined by Robertson(2010). Additionally, as presented in Søraa (2017), we could think about just calling robots “it” no matter how humanoid they are shaped.

2.2.5 Example: The Genderless Voice

One example that nicely illustrates Schiebinger's third point is **"Q"**[7], a genderless voice, which is created "to end gender bias in AI assistants". The reason the researchers made "Q" was to offer an alternative to the often gendered technologies, since they reinforce and perpetuate a "binary perception of gender".
This example appears especially tangible, since voice assistants, such as Siri, Cortana and Alexa are already part of our everyday lives.

3 Use Cases

3.1 Care Robots

A vast amount of literature can be found in the domain of care robots, however, mostly not directly from a gender or feminist perspective. Reasons for highlighting this field in the context of this work can be conceptualized from at least two aspects. First, care work still has gendered connotations. The implementation of care robots will thus affect women, in particular.
Second, when imagining care robots in old-age homes, the residents dealing with robots are more likely to be women, since a higher percentage of women are admitted to such homes (McCann, Donnelly, & OReilly, 2012). Nevertheless, from an intersectional feminist standpoint, it is necessary to also highlight the perspective of the care receivers independent of their gender identity.
However, especially the many ways in which (emotional) care is handled as unpaid labour, makes the issue an inherently feminist one. Topics raised in literature are the care-reciprocal, meaning that care needs to be something symmetrical, furthermore, deception and a discourse about supplementing versus substituting care workers. Also participatory technology development seems interesting in this case, when negotiating who is regarded as an expert. Who is asked and who gets left out in the design process of care-related robots?
Jennifer Parks (2010) looks at the case of care robots from a feminist perspective focusing on the often exploited care workers. For her, care is first a political issue and then a moral one, and although she deems the perspective of the care recipients to be important, she focuses on the care workers in her article. Whereas she does not appear strongly averse to care-robots in the beginning, she becomes more critical towards the end. Cases she deals with are located in Japan, Germany and the US, where major cultural differences can be observed.
Moreover, she highlights more general concerns related to care, which can be observed today as well, such as cost-cutting, decreasing care-ratios and shortage of caregivers. While she expresses her hopes, that "the cost-cutting that automation offers could lend itself to improved social interactions" (ibid., p. 115), she worries that technological solutions will not yield improvement with regard to increasing social isolation.

[7] https://www.genderlessvoice.com/

Important aspects to consider when building care robots would be to create an in- frastructure, that highlights the needs and demands of people who are confronted or might be confronted with robots in the care sector. A value-sensitive design, which means including ethics in the design process, and promoting “the fundamental values in care” (van Wynsberghe, 2013, p. 408) as suggested by Aimee van Wynsberghe, could be a good basis for this. She thus also promotes interdisciplinary collaborations among diverse researchers. Here, the question could be raised as to whether a transdisciplinary approach involving caregivers might be even more advantageous.

3.2 Robots in the Domestic Sphere

When looking at Roomba, the vacuum cleaning robot, it is undeniable that robots have found their place in the domestic sphere. This opens up feminist questions but also questions regarding gender, which are obviously not that new, since the domestic sphere has always been one of feminism’s battlefields. The question about gender-codedness of technologies has already been dealt with by Judy Wajcman in 1991. Wajcman is an important scholar in feminist sociology of technology who also worked on technologies in the domestic sphere. The main arguments of her work are that despite theenhance-

ment of domestic technologies, no liberation of women in the domestic sphere has been achieved. Instead of having more leisure time, (hygiene) standards were raised and not much has changed. She presents three categories of unpaid work (ibid, p.93): “rou- tine domestic chores (cooking, cleaning, other regular housework), shopping and related travel, and childcare (caring for and playing with children)”, it is conceivable that all of these could be done by robots in the near future. Now the question arises as to whether her arguments will still hold for domestic robots, or if robots disrupt the continuity. Nev- ertheless, taking Judy Wajcman’s thoughts into consideration appears productive when it comes to thinking about, but also developing domestic robots. Similar to Haraway’s promise that technology is emancipatory, this first advancement in home automation did not bring relief, and it is not self-evident when looking at Robertson’s report on the “Inobe family” that the liberation of housework by robots will take place.

Fortunati (2018) deals with the topic from a materialist feminist perspective several years after Wajcman, at a time when robots started to become reality, and answers the question, why there has been a shift of robotization from “the factory” to the domestic sphere. While, the domestic sphere had the reputation of being “backwards” it is now the place of innovation, Fortunati argues. “White goods” (domestic appliances) became more interesting than “Brown goods” (consumer electronics). Furthermore, Fortunati tries to shed light on the attitudes of people towards robotization and finds that in contrast to the 2014 Eurobarometer (a public opinion survey performed by the European comission), pupils in her sample could indeed imagine robots in the domestic sphere, including domestic use, care and education.

3.3 Sex Robots

Concerning the topic of sex robots, at least two different perspectives can be found. Kathleen Richardson (2015) takes up an abolitionist feminist approach, and dooms sex robots by analyzing their risks and furthermore initiates a campaign against sex robots. She criticizes the commodification of women's and childrens' bodies, and condemns sex- ual exploitation of women and children. The link between prostitution and sex robots comes from the chess player and AI researcher Levy, who highlighted this ostensible analogy. Both are problematic from Richardson's perspective. For her, sex needs the symmetrical component and can't exists in the asymmetry, which is the case in robot "sex" but also in prostitution/sex-work. She also rejects the argument, that an imple- mentation of sex robots would decrease the number of women exploited in sex work, since the percentage of men taking advantage of prostitution has increased, although the sex industry increased as well. Moreover, together with others participating in the Campaign against Sex Robots she believes, that these robots in the form of women or children might potentially be harmful and increase societal inequalities.

Tanja Kubes from the Technical University in Munich, just recently turned her re- search focus to robots and more specifically sex robots. In a workshop unit called "Let there be pleasure! Gender-Queer Perspectives on Sex Robots and Robot Sex", she presented her approach to dealing with sex robots from a gender-queer perspective, highlighting the emancipatory potential of queer pleasure-bots. Similar to Richardson, she critiques the human-like model, which is far from representing diversity and takes stereotypes to the extremes. However, she does not reject sex robots completely, but argues for more diversity and "queerness" in sex robots meaning that the robots don't have to resemble humans, but that they could "transcend the humanoid limits". In her talk this was accentuated with a bright and colorful image of sex toys of different shapes and colors.

Questions that could be raised in this context include the implications of such hyper- gendered fembots on sexuality. How consent plays a role in the debate around sex robots; and what emancipatory potential is present in imagining "queer" sex robots?

3.4 Masculinities and Robots

In the course of this review, we have seen how robots are gendered and why. In many cases, "female" robots seemed prevalent, after the engineering of a slender shape was fig- ured out. However, there is one field where the "gender-of-choice" seems to be masculine: security robots and the like.

Heather M. Roff's (2016) work deals with the gender performance of robots built for dangerous environments. Based on the "Robotics Challenge" of the United States De- fense Advanced Project Agency, also known as DARPA, she tackles the issue of warbots, or more correctly "rescue robots" from a gender perspective. The initial point of her paper is the evaluation of the presented robots with respect to their potential gender. Thereby, Roff looks at the "gendering-processes" of the robots built for the DARPA challenge.

One issue that appears evident in this field is the reproduction of "hegemonic mas- culinity". Roff argues, "The humanoid robot fighter is the ideal of masculinity in western culture, for it

represents an ‘independent, risk-taking, aggressive, heterosexual and rational’ being free from any weakness, particularly irrationality, frailty, emotion or desires.” (ibid., p. 2) Furthermore, in her article, she outlines three potential aspects through which the construction of gender can take place, namely: “hardware”, “naming”, and “software”. (ibid., p. 2) The third aspect, the software, focuses strongly on machine learning and AI and falls thereby in the field of critical algorithm studies, with an em- phasis on gender bias. The hardware as well as the naming aspect are strongly in line with discussions found in the area of “gendered robots”, as described in the respective chapter of this review. As outlined, her empirical case is the DARPA Robotics Challenge where the majority of robots in the contest were humanoid, and many of them gendered, mostly masculine. Cues for their gender were either the hardware or the name and rep- resentation of the robot. Valkyrie, a robot with “breasts” - which are said to serve as a place for the batteries, yielding a more preferable center of mass for their aims, posing with “one hand on hip, one arm effortlessly hanging to one side with the fingers relaxed. Its shoulders are not squared, but one droops slightly more than the other” (ibid., p. 6) contrasts its “male” opponents, such as Atlas, Hercules, Helios, Thor and Florian.

As mentioned at the beginning of chapter 3, HRI studies often try to evaluate, the tasks for which a robot should be made as gendered. Masculine robots “score well” in tasks surrounding security (cf. Tay, Jung & Park, 2014). Trust also plays a major role in HRI studies, Gallimore et al. (2019) present a “RoboCop” via video to their participants, to evaluate its trustworthiness. Although, the robot does not have many gender cues, it is declared to be male. Although, the gender of the robot is mentioned in the limitation of the studies, the authors do not reflect upon potential negative implications of such a gendering. While, in many cases “female” robots were preferred (educational settings, domestic settings, care settings, sex robots), war bots, and security robots, tend to be gendered “masculine” if they are gendered at all.

4 Conclusion

The aim of this report has been to make readers more sensitive to the need to integrate a gender(ed) perspective on research in robotics and human-robot-interaction. By intro- ducing examples of gendered and genderless robots and howgender is already integrated in research, my aim was to motivate readers to question their own assumptions about the “mechanical gender” or gender more generally.

Furthermore, it appears that the current discourse on robots is characterized by high expectations. Spectacular announcements of new prototypes usually turn out to be presentations of minimal progress. Instead of autonomously acting robots, very often remote-controlled artifacts are presented. Japan’s immigration laws have been eased, to counter the lack of care workers, rather than allow the employment of care robots. This might prove to be a stroke of luck. Slow progress allows for more reflection and demo- craticdiscourse on issues such as: **Where do we want to encounter robots; Should they be humanoid and why? or in which cases? Why they should or should not be gendered and what implications this gendering process might have; and what it means when a study shows that a feminine/masculine/gender neutral robot is more accepted?**

The literature presented hints at examples and analyses related to the topic, in more and sometimes less abstract ways. Obviously, it is not easy to find a “recipe”, an “algorithm” or a “panacea” for creating robots in a gender-sensitive or non-binary way. However, Londa Schiebinger (2018) offered a helpful set of possibilities for doing so. **Why not challenge current stereotypes and create a genderless or genderfluid robot?**
Haraway’s (1991) promise of emancipation and liberation in a post-gender world are presented when discussing sensitizing concepts. One last question could explore **how technologies/robots need to be designed to enable a deliberating and eman- cipatory futures.**

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