# Critical Perspectives in Human-Robot Interaction Design



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# 8 Critical Perspectives in Human–Robot Interaction Design

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Robots depicted in science fiction and popular culture are typically imaginary creations with speculative features and unrealistic functionality. While these can aid us with future interpretations and the ethical deliberations of what robots can or should become, they also contribute to the shaping of robots, myths, and magical thinking. Such myths affect not only popular beliefs among the general public, but also how scholars in human–robot interaction (HRI) conduct research (see e.g. Fernaeus et al., 2009; Richardson, 2015; Sabanović, 2010). For instance, robot researchers may propose that robots will successfully supplant traditional human roles in everything from nursing to driving in heavy traffic.

In recent years, an underrepresented yet growing body of research in HRI has been aimed at addressing the need for more nuanced, situated, and critical perspectives in research. This includes calls to the research community with regard to exploring alternative epistemological groundings and associated critical topics in HRI (see e.g. Serholt et al., 2022, Ljungblad et al., 2018, Fernaeus et al., 2009, Bischof et al., 2022). The greater aim is to reframe HRI research toward designerly approaches that are more situated, reflective, critical, and inclusive. Examples of such endeavors could be to situate one's research in connection with official policies or guidelines, such as the ACM code of conduct (ACM code of conduct, 2023), or orient research with urgent topics proposed by (United Nations, 2023), which we explored in our first initiative at the workshop "Critical Robotics exploring a new paradigm" (Ljungblad et al., 2018). That time we used a backcasting method to connect emerging robot research themes and topics to UN goals. Since then, we have invited other researchers to contribute to a special issue with their perspectives of what constitutes critical robotics research (Serholt et al., 2022). The contributions highlighted aspects that are hidden or overlooked in research, providing many insights into the need for critical robotic perspectives and approaches. Several aspects related to methodology address the risks of oversimplification and deconstruction of work practices to fit a predefined technical solution (Burema, 2022; Maibaum et al., 2022) and acknowledge that user-centered methods can still lead to undesirable solutions (Dobrosovestnova et al., 2022; Weiss & Spiel, 2022). Another related issue was to reconsider design goals with human values at the center, for example, to create robots that manifest the value of reciprocity between humans rather than fake reciprocity in a social robot (van Wynsberghe, 2022).


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In general, any research builds on moral or political values (Friedman, 1997), which raises questions about what constitutes genuine matters of concern within a research field (de La Bellacasa, 2011; Latour, 2008). Facts in research are not necessarily matters of concern in society as a whole, even when researchers stress that their research matters (Latour, 2008). If we develop more sensible ways to understand and successfully address real matters of concern in society, this may also lead to interesting discourses in research. This in turn could raise deeper critical questions about the design and use of robots in society as lenses into a bigger phenomenon.

> As artists continue to push the very limits of art, traditionally defined by discrete and inert handmade objects, they introduce robotics as a new medium and material at the same time that they challenge our understanding of robots - questioning therefore our premises in conceiving, building, and employing these electronic creatures.
>
> (Kac, 1997)

Compared to the myths we construct from science fiction movies, robotic art objects can be grounded in realistic technical functionality, and at the same time be norm-creative and innovative in their critical inquiry. Criticality in robotics can also successfully draw inspiration from other research fields, such as art, where the critical reconfiguration of robotics has essentially been done for more than 100 years (Csikszentmihalyi, 2022; Kac, 1997). Artistic methods can be used to question and explore our relationship to robots and robotic materials (Yolgormez & Thibodeau, 2022). For example, artists may create technically working solutions that hybridize robotic functionality with other media, systems, contexts, and even life forms (Kac, 1997). While doing so, they challenge our understanding of robots as a design material (Csikszentmihalyi, 2022; Jacobsson et al., 2013). This approach supports playful and critical reflection on robotics with the possibility of generating insights relevant for, but also far beyond social, aesthetic, and practical perspectives.

Verbeek (2011) describes how ethics and technology are deeply interwoven, and the need to make the implicit morality of things explicit in technology and other artifacts. In Human–Computer Interaction (HCI), several related critical research directions have surfaced through the years. Friedman (1997) contributed with the value-sensitive design perspective in 1997, articulating value and bias, and how technological artifacts inherently are political constructions. This in turn articulated the need for critical technical practice (Agre & Agre, 1997). Later on, perspectives and design approaches such as critical design (Dunne & Raby, 2001), reflective HCI (Dourish et al., 2004), criticality (J. Bardzell & Bardzell, 2013; Pierce et al., 2015), and adversarial design (DiSalvo, 2015) have emerged. Critical design (Dunne & Raby, 2001) addressed the everyday complexities of human pleasures, along with the misuse and abuse of electronic objects, and how complex realities challenge the promise of techno-utopian visions (J. Bardzell & Bardzell, 2013). Speculative design and adversarial design (DiSalvo, 2015) offer an additional lens on criticality approaches, such as prototyping a potentially evil design of an interface to understand ethical risks.

Speculative design and design fiction focus on producing illustrative scenarios, employing storytelling in the construction of imagined and hypothetical futures. Similar to artworks, critical and speculative design can push boundaries, challenge assumptions, and promote critical engagement with robot designs. Such work can go deeper than producing merely affirmative design. Without a critical stand, affirmative research may reinforce existing and occasionally problematic norms. Critical research instead engages directly with deterministic technological views; economic expectations; and oppressive structures. Such deeper and broader reflection can highlight and ground essential critical sensibility within the field (J. Bardzell & Bardzell, 2013). For example, Auger (2014) speculates and illustrates some robot-friendly aesthetics of existing artifacts in the home, such as plates and bed sheets. This supports conceptualizing robotic technical limitations and unexpected meanings such artifacts may create. Luria et al. (2020) focused on a non-utilitarian view of robots, creating speculations of destruction. Such adversarial design can shine light on misuse, and raise ethical concerns through fiction (DiSalvo, 2015). Parallel to these approaches, the practice of "undesigning" began to surface in the wider conversations associated with HCI (Pierce, 2012). Undesigning refers to the practice of reflecting on inaction as a possible activism, and the need to sometimes remove, exclude, replace, or restore technology. This recognizes that people may need something else than what they intentionally articulate, that some groups may be excluded from use, and how other groups may actively avoid use (Pierce, 2012, 2014). We can see the need for this when the implications of collected data clearly do not seem to support the initial design idea (e.g. a robot) (Baumer & Silberman, 2011).

Social science and humanistic research fields have a strong tradition of criticality, and we would like to see this embedded into the newer discipline of HRI. There is much to be contemplated after all – social structures, agency, power, and social dynamics. Such critical theory can also be profitably explored in conjunction with additional theoretical perspectives. We would benefit from an HRI discipline that was deepened through engagement with critical theory, as well as feminist theories (Gemeinboeck & Saunders, 2023; Winkle et al., 2023).

There is recognition of the need for this in the wider context of society. There are several overarching manifestos, projects, and organizations that point toward the harmful impact that AI and related technologies may have on society. They argue the need for ethical design and legislation. We can draw on these for inspiration. Examples include the Foundation of Responsible Robotics (a non-profit and non-government organization); Responsible AI (Dignum, 2019); and Trustworthy Robotics (Brando et al., 2022). Similarly, the Vienna Manifesto aims to build a community of scholars; policymakers; industry; and other actors to ensure that technological development remains centered on human interests (van Wynsberghe & Sharkey, 2020). To mitigate algorithmic bias, Black in Robotics (BiR) constitutes a community of Black researchers, industry professionals, and students with the joint aim of advocating for equity and ethical and equal outcomes.

## 8.1 CRITICAL ROBOTICS AS A RESEARCH PROGRAM

In this chapter, we propose Critical Robotics as a design research program. This is intended to support researchers in applying more critical and interdisciplinary perspectives in their work. We present this as a transitional theory – a conceptual structure aiming to support the formation of alternative research approaches and strengthen alternative epistemological grounds for HRI research. Research can navigate the design spaces between theory and practice; between art and science; and between freedom and method (Redstrom, 2017). Importantly, such approaches allow us to break away from the easy answers associated with our immediate intellectual habits. One intent of this is to investigate basic definitions of core concepts in design, allowing us to make and create them from new angles (Redstrom, 2017). A program is a way of dealing with complexity, in design and we do this by creating a composite definition of what designing is:

> In particular, programs allow us to work with matters pertaining to worldviews, the basic set of belief that design depends on, which are rarely made explicit in practice.
>
> (Redstrom, 2017)

According to Redstrom (2017), programs can perform several roles. A program connects basic definitions to methodology, for example, by illustrating what is typical, excluded, or a matter of something else. Our critical robotics program builds on design and study examples, as well as contributions from the research community to articulate and exemplify concerns part of a critical robotics perspective (Ljungblad et al., 2018; Serholt et al., 2022). We now offer some of our own interdisciplinary work as exemplars, illustrating our own stand. For example, to complement the specific lab experiments that are common in robotics, we have conducted ethnographic studies addressing social and other challenges and overall experiences of using robotic products in homes and engaged in children's perspectives; a user group that is often missing in robotic research (Fernaeus et al., 2009; Gamboa, 2022; Ljungblad, 2023). We have studied existing professional drone pilot practices, and mapped out specific areas of research that are missing and need to complement current lab experiments and speculative scenarios of drone use in research (Ljungblad et al., 2021). We have studied how teaching with a social robot in a real school environment was experienced by students, raising awareness of the trouble that occurs in conversations with social robots and how this can affect the overall learning situation (Serholt et al., 2020). Our research has also looked into how a transportation robot used at a hospital can raise specific ethical issues and affect the experience of a work setting (Ljungblad et al., 2012; Nylander et al., 2012). We have also learned from artists and their practices how robotic artworks open for close encounters with the general public in the showroom, generating playfully ethical and aesthetic questions, beyond existing myths (Jacobsson et al., 2013). Finally, we have conducted critical and inclusive conceptual design work on drones intended for the showroom to open up a critical debate about the use of drones (Gamboa et al., 2023).

To develop this program, we take inspiration from Redstrom (2017). He describes how a research program can be characterized by both intent and unfolding, with a projection and a process that are intertwined. He builds his perspective on that of Imre Lakatos, viewing a research program as an overall framework, building on a set of series, and providing a foundation for future research within a specific worldview.

Redstrom (2017) emphasizes that theory in design is not a fixed or absolute entity but is continuously evolving and contested. It is shaped by ongoing debates, diverse perspectives, and new insights emerging from design practice and research. The overall goal of critical robotics is to strengthen the epistemological foundations of sound and desirable research that is excluded or exists on the margins, for example, due to not following a dominant research tradition. This we do by encouraging and nurturing additional reflective accounts and critical perspectives. So far, the program consists of a basic set of beliefs or constructs. We hope to see these evolving and growing in the field through design exemplars, case studies, and the development of mid-range theories. Our work, and its overarching context, represent some basic definitions connected to a critical robotics stand and methodology. In this chapter, we describe an initial set of constructs and invite other researchers to address these to strengthen design knowledge within HRI:

- Problematization
- Marginal perspectives
- Moving beyond user requirements
- The role of the designer

The above should be understood as interdisciplinary constructs to guide critical and ethical discourses in HRI research (Ljungblad et al., 2018; Serholt et al., 2022).

## 8.2 PROBLEMATIZATION

What is the essential research question for a specific robot project, and how does this question matter for the society? What is our role as researchers compared to industry and other knowledge-producing practices? Which stories of robots are we as researchers sharing and why (Brandão, 2021; Fernaeus et al., 2009)? Are robots approached as technological fixes to social problems (Sabanović, 2010)? Could specific design methods support us to reformulate the initial research question and avoid design fixation in research (Ljungblad, 2023)? When it comes to the more practical use of robots, the problematization concerns the initial research question and its context, the possible methods to question it, and setting a specific research direction. Problematization in critical robotics is about taking a stand to keep holistic and humanistic sensitivity and openness within the robotic research project. Specific methods (in design or research) may or may not support the researcher to view the situation from different angles and from the perspective of different stakeholders (Lupetti et al., 2021). Often, after gathering data, taking a critical look at the problematization and the initial questions will suggest the need to reframe the initial idea of a robotic solution or support (Ljungblad, 2023). Design processes of robotic art (Kac, 1997; Yolgormez & Thibodeau, 2022), critical design (Dunne & Raby, 2001; Pierce et al., 2015) and speculative design (Auger, 2014) are typically not oriented toward practical use, but concerned with raising questions and supporting ethical reflection. For such works, the problematization can be to question myths and assumptions of interactions with robots. Such directions may, for example, build on robotic social uselessness and the required human intervention of repair (Yolgormez & Thibodeau, 2022). It is also possible to introduce or apply theoretical perspectives and methods from other fields, building on specific research traditions. One such example is how to apply feminist theory and bring knowledge into pluralistic research practices in HRI (Winkle et al., 2023). This can support an alternative problematization and more norm-creative perspectives beyond a dominant research tradition.

The need for more situated knowledge perspectives in research was pointed out as early as 1988 by Donna Harraway (Harraway, 2013). Critical robotics research can look into how robotic products might change and disrupt socio-cultural life worlds (Hildebrand, 2022; Nørskov, 2022). As such, a researcher's ethical compass and belief system are important, to let nuanced sociological accounts of people's existing practices and their central values be interwoven into research (Dobrosovestnova et al., 2022). To gain novel and norm-creative perspectives, sometimes redesigning or even undesigning the imagined use of robots may be necessary. Such knowledge is also valid critical robotics research knowledge. It does not have to be about generating design implications for a robot, but can be framed as a springboard for a critical debate. For example, Lupetti and Van Mechelen (2022) worked with children in school with a deceptive robot to critically discuss and raise awareness of deceptive behaviors associated with societal myths and assumptions about robots. However, critical reflection on more practical use aspects of robots can also support a sound problematization.

## 8.3 MARGINAL AND NORM-CREATIVE PERSPECTIVES

The field of HRI, in its interdisciplinarity, has focused on finding ways of studying robots that can be generalized. The goal is to conform to the criteria of rigor commonly accepted in engineering or psychology research. However, design knowledge is typically less concerned with generalization, and has other criteria for what is considered rigorous. Marginal practices may reveal innovation opportunities, studying marginalized users may lead to more accessible, usable, and norm-creative solutions, and the best possible methods for design can be the methods uniquely created for the specific situation at hand. As pointed out by (Lupetti et al., 2021):

> In this process, design methods help bridge the gap between the technical research interests that drive most engineering approaches in robotic research with the actual sociocultural reality and needs of potential users that robots may interact with.
>
> (Lupetti et al., 2021)

Design methods can make use of marginal perspectives that are usually pushed to the margins by existing assumptions. This means to incorporate not only what is a central tendency, but to take a stand to look at the edges of what is considered accepted knowledge within a discipline (see e.g. Gemeinboeck & Saunders, 2023; Luria et al., 2020; Winkle et al., 2023). Design methods can make visible and make use of what is usually perceived as errors or undesirable effects in research. These may include breakdowns, failures, and collisions. It can be argued that exposing knowledge that is usually hidden is an essential process of research – we should not only focus on contributing with perspectives on what should be done, but also on what ought to be avoided. Design processes are complicated, naturally exploratory, and hardly ever based on a hypothesis. Rather, what is prioritized is a sense of the possibility to be found in deeper engagement with emerging knowledge – problematizing what may be generally taken for granted (Gaver et al., 2022).

The favorable view of emergence (the unexpected things that happen in research) can be celebrated in design, and supported by methods such as research *through* design. Within robotic research, this implies studying and designing robots in uncontrolled settings with occasionally uncomfortable assumptions. This allows for a variety of potentially unexpected interactions to surface. These can then be analyzed and discussed in detail not merely as hypothetical scenarios but as ill exceptions to the habitual expectation of the rule.

The acceptance of alternative methods and perspectives is of great importance to the inclusivity of robotic research. Marginal methods do not only give voice to unusual perspectives, they also have the potential to make the research more accessible to those who are not usually perceived or incorporated as researchers. This allows for the surfacing of alternative forms of knowledge that do not follow the standardized ways of conducting research, supporting norm-creative approaches where research goals, perspectives, and discussions can be formed by the experience of marginal and typically excluded groups (Ljungblad, 2023). As previously mentioned, (Nanavati et al., 2023) explicitly include a community-based participatory research method, making one of the community researchers into a co-author.

## 8.4 BEYOND USER REQUIREMENTS

Even if user-centered methods such as participatory design are used in a design process, this does not guarantee that the result will be desired or accepted by the intended users (Lee et al., 2016). In our special issue on Critical Robotics 2021 (Serholt et al., 2022), several key contributions pointed out the risks of neglecting complexities in human practices in favor of packaging user requirements as design implications. For example, if care practices are deconstructed to give form to well-defined technical problems, this can lead to mechanization of care (Maibaum et al., 2022) and exacerbate stereotypes of care workers (Dobrosovestnova et al., 2022). Similarly, ageism occurs when older adults are depicted as fragile, vulnerable, and burdensome care recipients in need of a robot (Burema, 2022). When focusing research on socio-emotional relationships with robots, researchers may miss the more intrinsic and humanistic aspects of reciprocity among humans (van Wynsberghe, 2022). Moreover, much robot research involves primary users rather than the different types of tertiary stakeholders. This holds true even if the latter will have a primary role in the potential use. Also often absent is the role of lay experts in the potential implementation of robots, and the impact of power-balancing stakeholders (Weiss & Spiel, 2022). Methods such as autoethnography of robotic products can go beyond user requirements to focus on lived experiences in family life (Gamboa, 2022). A robot artifact presented for a user may “steal the show” when the researcher may need to know more about people’s existing practices, experiences, and everyday situations.

For example, in assisted feeding, this can lead to merely reactive responses to a robotic feeding device, instead of learning about what is important in the overall meal experience (Ljungblad et al., 2021). Similarly, a focus on merely functional requirements may lead to rejection if the robot clashes with social and aesthetic values (Ljungblad, 2023). Another related aspect to be considered in user requirement gathering is response bias, such as social desirability. This is where people try to please the researcher and answer something that is socially acceptable rather than give honest answers. The presence of a robot can sometimes distort what may in reality be considered socially acceptable or not.

There are also different types of goals within design activities that sometimes have less to do with user requirements. Concept-driven designs, such as the critical, speculative, and artistic lenses, may explore and focus on one specific aspect of interaction intended for a showroom (Koskinen et al., 2011). These may include breathing to question and expand upon possible modes of interaction from a pluralistic perspective (Gamboa et al., 2023). The different mindsets create different expectations of the user requirements as they may be intended to be experienced in different contexts, whether it is a showroom, or a personal conversation piece.

Finally, another aspect going beyond user requirements is to consider how methods are applied differently by different researchers (Boehner et al., 2007). Some data collection methods were developed as inspiration for design, rather than approaches for requirement gathering – for example, cultural probes. An additional risk comes with viewing ethnographic methods as mere tools to get at user requirements (and implications for the design of robots). Such perspectives do not do justice to the very rich insights that they can provide with regard to human practices (Dourish, 2006).

## 8.5 POSITIONALITY

> Practice should involve a disclosure of the researcher's position in the world, her or his goals, as well as the researcher's position in her or his intellectual and, to an appropriate extent, political beliefs.
>
> (S. Bardzell & Bardzell, 2011)

A reflexive stance is not necessarily one that seeks to remove bias, but rather to be mindful of the researcher's positionality. Researchers can also strengthen or even alter their own position, by having co-authors that view, steer, and reflect on the research process from a marginal, alternative, and norm-creative perspective, such as when people with disabilities are co-researchers and co-authors (see e.g. Fossati et al., 2023; Nanavati et al., 2023). In feminist studies, strong objectivity was coined by Harding (1995) as a way to delink a "neutrality ideal" from standards aiming to maximize objectivity. Her perspective draws on standpoint epistemologies, arguing that all research (also natural scientific) is shaped by politics, institutional structures, and the specific languages employed. Weak objectivism defends and legitimates the problematic institutions and practices ideals – including the idea that it is possible to be value-neutral, normal, natural, apolitical, and absent of gender coding. Strong objectivity, on the other hand, embraces the role of experience in producing knowledge. It advocates global and local social changes, pointing out the need for diversity in science to gain the value associated with multiple diverse perspectives. To build on Harding's (1995) ideas from a methodological perspective, we see the need for researchers to be open with their position and open up for pluralism. This also includes welcoming the employment of a multitude of methods, including from outside of the HRI field. Along with this, we argue the need to actively search for methods that can question stereotyped perspectives and biases. We believe that all researchers have a moral compass, and that we all can contribute when it comes to taking a stand. Researchers can learn much if they are clear on their own position and research aims. Furthermore, transparency of the research process and honest reflections on failures can support other researchers to know better how to apply methods. As designers, we can use methods that reveal failures early and learn from our own and other people's failures when learning and practicing methods.

## 8.6 INVITATION TO CONTRIBUTE

Doing critical robotics requires taking a reflective and occasionally uncomfortable look at the fundamental goals and approaches of our field. This is why we believe that creating and growing a platform for this type of research is essential. Overall, examples of such work include questioning one's own assumptions of design or practice (Baumer & Silberman, 2011); the discourse and writing traditions our fields adhere to (Pierce et al., 2015); or the institutions and the existing structures we are all part of and are influenced by every day (Winkle et al., 2023). This will typically also involve a need to clash with the dominant research paradigm (see e.g. Harding (1995)). It will mean engaging critically with specific political and institutional structures. It will also require greater acceptance with regard to what is considered rigorous scientific writing and methodological approaches. It requires a greater integration of marginal perspectives, along with a greater willingness to engage in norm-creative perspectives. This is the whole reason for this design program as we outline it here. Any design program needs exemplars of research that can be used for clarification and inspiration; the more we have, the better. This is important in order to make sustainable change in the field. We hope to encourage a wide variety of research activists to come together to support each other. We want to embrace the joy of discovery, failures, and fun and thought-provoking research. We want our work to engage with people and robots with humor, and in playful and critical ways. This is so the community of researchers and other stakeholders can build upon each other to become more than a discipline, turning into a growing and flourishing community. We hereby invite other researchers who align themselves with our stated values to contribute to the further exploration and development of critical robotics in HRI. We would like to see a discipline that engages constructively with failures and negative results so as to avoid the overly positive spin that publication bias puts on the myths of our field. The questions we pose, the methods we use, and the things we use, are all related to ethical and moral considerations (Verbeek, 2011), and there are many exciting ways to discuss and reflect on these.

Here are some suggestions of topics for future critical robotics research:

- Work that defends and explains criticality in robotics, as well as questions critical of robotics as a program (see e.g. (Csikszentmihalyi, 2022))
- Research that clarifies and extends our critical constructs of problematization, marginal perspectives, user requirements, and positionality
- Research that takes a stand against far-fetched and unrealistically deceptive robotic visions – for example, by pointing to communication issues in robotic research (see e.g. (Fernaeus et al., 2009))
- Novel design methods to incorporate and systematize feminist and other norm-creative perspectives
- Case studies and explorations where there are rich accounts of people and their lived experience
- Deconstructions of robotic products, i.e. presenting existing technological limitations and practicalities
- Norm-creative perspectives of robots, exploring different types of materializations, and very limited practical use of robots in favor of social or aesthetic use
- Design approaches to playfully identify design fixations, bias, and stereotyping aspects

We also envision contributions that go way beyond this – those that inspire, provoke, and critically reflect upon robotic research. We hope to see you out there!

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