Configuring the User: “Robots have Needs Too”

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ABSTRACT
Users have played a prominent role as “objects of study” in HCI, CSCW, and HRI (Human-Robot Interaction). Researchers have begun to problematize the asymmetric relationship between technical experts and users. In this paper, we focus on how roboticists—borrowing a term from Steve Woolgar—“configure” their robot users. Instead of focusing on what roboticists think of their robots or what users think of robots, we ask, “What do roboticists think of users?” Utilizing two exercises we call futuristic stories and value index cards, we conducted semi-structured interviews with roboticists to examine their discourse on robotics, robots, and users. We found that roboticists framed users as inevitably transforming from a naïve user to a sensible user equipped to handle their ideal, utilitarian robot. Our findings illustrate that roboticists and designers need to make transparent what forms of future users they desire and expect in their design processes.

Author Keywords
Futuristic stories; Human-robot interaction; Roboticists; Robotics; Robots; Users; Value index cards

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Šabanović, in her study [54] of the institutions that research, design, develop, and promulgate robotics to society, argues that there is a somewhat troubling asymmetry between technical experts and everyday people:

> Everyday people—the potential users of technologies—leave decisions about the directions for future development to technical experts…The potential users of robotics technologies come to occupy a secondary role in the process of designing robotic technologies; they are present in the field as objects of study rather than active subjects and participants in the construction of the future uses of robots (p. 440).

Indeed, we know that users have played a prominent role as “objects of study” in HCI, CSCW, and HRI (Human-Robot Interaction). This work has yielded insightful findings on how users interact with robots both in the laboratory and in the wild [36]. For example, research has shown that some users anthropomorphize and unconsciously trust robots [21].

There has been little work questioning this asymmetric relationship in our “robotic futures” [54]. For example, Su et al. [60], after examining videos featuring robots in the healthcare industry, found that institutions of robotics frame robots as miraculous entities that will save patients without disrupting the status quo; the robot thus becomes an indispensable and inevitable technology for progressive clinics and nursing homes. However, is this the right vision to have? For instance, who would be tasked to maintain these healthcare robots?

Those who create digital artifacts actively occupy and maintain a privileged position above their users. Woolgar [69], in his famous article on “configuring the user,” notes that designers seek to promote preferred readings of their technological artifacts, even during so-called user-centered evaluations. Interfaces feature politics in the sense that they subjugate the user, prodding them to become the “model” user for the machines. The machine then represents the values of the designers.

Likewise, we can imagine that roboticists themselves, in their multifarious roles as designers, researchers, and developers, may have a strong influence on their robots’ designs. Their beliefs on what constitutes, for example, AI may affect their view on what is a human and what is a machine [51, 61, 62]. Subsequently, the robot’s design may be influenced by these viewpoints. Certainly, HCI and science and technology studies (STS) have argued that a roboticist’s values and perspectives are inseparable from the robots they construct [51, 67].

In this paper, we focus on how roboticists configure their robots’ users. We are interested in the question of what the future holds for robots. Instead of addressing what roboticists think of their robots or what users think of robots, we ask, “What do roboticists think of users?” By

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examining this question, we can also indirectly begin to uncover the inherent values of roboticists and how these values influence the robots they create for the future. Roboticists, researchers, and industry actors reside in a position of power to produce knowledge that may turn into "products." Kinsley [30] argues that "it has become increasingly important to recognize the agency of future visions that may underlie such work and accordingly attend to how they are constructed" (p.1565).

Utilizing two exercises we call *futuristic stories* and *value index cards*, we conducted semi-structured interviews with 23 roboticists involved in the field of Human-Robot Interaction (HRI). We sought to understand from a social constructivist view [5], how roboticists construct a reality which legitimizes certain forms of robotics, roboticists, robots, and users. In other words, we examined how they view their field and the various actors involved in it.

We make the following contributions:

• We conduct one of the first studies asking roboticists themselves to reflect on their users. We argue that roboticists construct a user transforming from a current, naïve user to an anticipated, sensible user. The latter echoes the roboticists' viewpoint that robots should be treated on their own terms as programmable, predictable machines that require users to adapt.

• We argue that roboticists, even those engaged in user-centered disciplines such as HCI and CSCW, see an ideal robot as diametrically opposed to how robots are envisioned today by users.

• We revisit issues commonly brought up in CSCW—broadly, who should we be designing for, and can we satisfy multiple groups of "users"? We discuss attempts to design for roboticists and/or users, and we conclude that the focus should change from simply designing together to managing expectations between the two groups. By reconceiving users in temporal terms, we suggest designing for user transformation.

RELATED WORK

In this section, we discuss how robots have been configured in previous work. First, we discuss how robots have been portrayed as tools—as machines or inanimate technologies. Second, we describe how robots have been portrayed as things with agency—as having attributes like emotions and autonomy [2, 63]. Third, we cover studies that portray robots as both tools and things with agency to varying degrees. Lastly, since our study deals with the social construction of users, we summarize work on the conceptions designers hold of users.

Robot as a Tool

Future robots have often been portrayed as tools by study participants [16, 63, 70]. For example, people anticipated a future where everyone is comfortable with robots like we are with domestic, everyday technologies such as cars [70]. Another study developing a future domestic robot [64] found that people wished to have a robot that functioned like a butler. Dautenhahn et al. [16] also observed people predicting that domestic robots would become butlers or assistants—multipurpose robots for the household.

Robot as an Agent

Participants have a tendency to either anthropomorphize robots or draw upon metaphors such as animals and living things to describe robots [18, 21]. Forlizzi and DiSalvo [21] found that study participants frequently expected a Roomba to have "the ability to learn" (e.g., adapt to their environment and carry out new functions over time). In contrast to expectations before adopting the robot, participants become more impressed with the robot's functionality after actually using it. Users also treated robots like animals by whistling at or feeding them. Studies [57, 71] on publicly deployed mobile trashcan robots found that people regarded them as pet dogs.

Robot as Tool or/and Agent

Alač describes both tool and agent as co-existing rather than separately existing in a robot [2]. Studies have found people describing a robot as an alien, worker, or work partner [38]. A naturalistic study conducted in a campus building [36] discovered that an almost equal number of participants treated a reception robot as a machine and as a service person. Participants had different approaches with the reception robot. Those who perceived the robot as an agent first greeted the robot, while others immediately tried to interact with the robot by typing commands on a keyboard connected to the robot. Similarly, a content analysis of a robotic pet company's online forum [10] showed people describing robotic pets as either inanimate artifacts (e.g., computer) or having attributes of living things (e.g., sleeping).

Robot perceptions change over time and also influence their adoption. Sung et al. [64] conducted six months of longitudinal fieldwork with 30 households to examine how participants became used to domestic robots. Before adopting robots and after adapting to them, participants perceived the robot as a tool. Yet, during the actual adoption and adapting stages of robot use, participants viewed their robots as agent or mediators that engaged them with family members or in environments.

In a similar vein, how a robot is perceived can indicate whether someone would adopt a robot or not. One major finding across a number of studies [10, 22, 23, 25, 47, 58, 59] is that participants' impressions toward robots tend to get better over time. When a robot seemed to have the ability to act on its own, older adults had more positive impressions of the robot [58]. From this, the study [58] suggests that robots would more likely be adopted. Another study [25] showed that when older participants perceived the robot to have an ability to adapt to their changing needs, they felt more anxiety toward the robot; this anxiety indirectly discouraged participants from future use of the robot.

Researchers have recognized several factors such as gender and age, which may influence one's perception of robots [55]. In an organizational study of hospital delivery robots [45, 52], a range of factors (e.g., practical benefits from the robot, goals of different departments/ work units, physical environment, and emotional/social/political contexts) influenced how people perceived a robot. For example, a nurse at a maternity unit saw the robot as delightful while a nurse at a cancer ward felt negatively toward the robot.

In sum, many studies have shed light on what perceptions people have about robots. These studies have shown that a robot can be perceived as either a tool or an agent. This perception is in a constant state of change over time and linked to the eventual adoption and use of a robot. Lastly, a multitude of factors influence the taking up of a particular perception of robots.

To the best of our knowledge, there is relatively little work that has explicitly investigated the robot designer, developer, or researcher perspective [51, 62]. An exception by Su et al. [60] investigated the discourse of YouTube videos created by healthcare roboticists and their affiliated institutions. They found a dominant discourse that seeks to legitimize robots in the healthcare industry by portraying them as mundane (e.g., will become coworkers) yet miraculous (e.g., improves healthcare) and sometimes preternatural (companions for older adults with dementia). Following Šabanović's call, our study seeks to flip the focus of previous studies and to instead examine the roboticist's viewpoint on their creations and their users.

Designers Configure their Users

Designers' intentions and values not only reflect the technologies they make but also configure their users' experience. Although HCI and STS scholars have broadly examined the relationship between designers and users, the designer's point of view has been paid comparatively little attention.

Scholars have shown that the designer's perspectives (e.g., presumptions and expectations) and user's behaviors (e.g., users' appropriation and use of technology) are closely intertwined with each other [3, 7, 26, 35, 69]. Woolgar [69] described how users' interactions with technologies were "configured" by researchers; this configuration depended on the ways designers arranged their design process and their communication with other departments in their organization. In another study [39], preconceived notions of older adults profoundly affected design decisions. Designers often see themselves as a point of reference when thinking about the user [51]. This "designer-centered" design process has been labeled "I-methodology" [3] and "I-design" [27]. In two case studies, Oudshoorn et al. [49] also found that designers relied on their own preferences and skills instead of researching users' actual interests and competencies [49, p.53].

METHOD

We conducted a qualitative study utilizing two methods: a semi-structured interview study with *futuristic stories*, and *value index cards* to understand the perception of future robots roboticists have and their values.

Field Sites and Data Collection

Our interview study was multi-sited. Semi-structured interviews [44] were conducted with 21 roboticists at a major international robotics conference on human-robot interaction (HRI) and at two university robotic labs. There is precedence [14, 42] for using academic conferences and their attendees as an information-rich [50] site for interviews, observations, and survey deployment.

The robotics conference was a single, opportune moment for us to access a diverse group of international experts in the field of robotics. The conference specifically emphasizes a multidisciplinary approach, and its past meetings have featured roboticists from not only engineering but psychology, design, and/or philosophy (ethics). This diversity of expertise was important to us because studies [13] suggest that the majority of roboticists have an engineering background, which strongly biases their views on robot design. We hoped to gain a more nuanced, diverse perspective by talking to roboticists who were not all from engineering fields. The conference was a four-day event attended by roughly 350 participants.

We focused on speaking with roboticists involved with humanoid robots. Humanoids, more so than perhaps other forms of robots, are expected to interact like humans do. The physical form of humanoids also demands careful consideration of ethical and social issues. Thus, humanoids necessarily involve collaboration with a wide range of disciplines beyond the technical and engineering sciences, such as philosophy and education, which may not be essential to other kinds of robots. We also believe humanoid research particularly shares the CSCW "intellectual mission" [1] to address the sociotechnical gap (between what people expect robots to do and what the robot technically could do) while adding an ethical angle (e.g., how much should we allow robots to do). Hence, we argue that roboticists involved with humanoids are uniquely qualified to offer an informed perspective on users.

We conducted 11 semi-structured interviews at the conference itself—during session breaks or right after the last session of a conference—in locales nearby the venue (e.g., at the hotel lobby, café, or bar). In addition, we took the opportunity to visit two robotic labs that were geographically close and affiliated with the conference. We interviewed 10 roboticists in these visits. In this paper, we also include data from two roboticists (R22,23 in Table 1) we interviewed in a pilot test whose insights proved useful. Each interview took between 30 and 70 minutes.

Detailed information on our participants is listed in Table 1. Our participants' research institutions were in the United States, United Kingdom, Belgium, Australia, Portugal, Peru, and Japan.

ID	Meeting venue	Research Area	Academic Position	Value Card
R1	Conference	Automation & cognitive robotics	PhD student	N
R2	Conference	Robots for emergency evacuations	PhD student	N
R3	Conference	Social and therapy robots for children	PhD student	N
R4	Conference	HRI, humanoids	Faculty	Y
R5	Conference	Bioethics, applied ethics	Faculty	N
R6	Conference	Applied psychology, education & media psychology	Faculty	Y
R7	Conference	Humanoids	Postdoc	Y
R8	Conference	HRI, social mobile robots	Postdoc	Y
R9	Conference	Domestic robot, social robots	Faculty	N
R10	Conference	Social robots, HRI	Robotic company Entreprene-ur (Ph.D.)	Y
R11	Conference	Social robots, HRI	PhD student	N
R12	Lab 1	Humanoid robots, oral language	PhD student	Y
R13	Lab 1	Robotics, roboethics	PhD student	N
R14	Lab1	HRI	Faculty, Director of Lab1	Y
R15	Lab 1	Humanoid robots, walking robot	PhD student	Y
R16	Lab 1	Humanoid robots, HRI	PhD student	Y
R17	Lab 2	Speech recognition, HRI	Faculty, Director of Lab2	N
R18	Lab 1	HRI, interaction design, roboethics	PhD student	Y
R19	Lab 2	HRI, electronic & computer engineering	Faculty	Y
R20	Lab 2	HRI, electronic & computer engineering	PhD student	Y
R21	Lab 2	HRI, electronic & computer engineering	PhD student	Y
R22	Local University	Robot simulations	Faculty	Y
R23	Local University	HRI, cognitive psychology	PhD student	Y

Table 1. Participant Demographics (N=23)

Interview Exercises: Futuristic Stories and Value Index Cards

Understanding the perspective of roboticists during an interview can pose methodological challenges. If we were to simply ask roboticists for their beliefs, this would likely be a daunting task to reflect on the spot. It would require our informants to reflect on their field in an abstract sense as well as articulate multifaceted, sometimes unconscious aspects about their motivations and everyday practices. Instead, Becker [4] suggests that social researchers focus on narratives of *process*. Direct questions of values are analogous to questions of "Why?" (e.g., Why should robots be designed this way?). Instead, questions of "How?" can lead us indirectly, and in better depth for the researcher, to "stories whose steps have a…logic as inevitable as the logic of causes" (p.61). When responding to how-questions, informants can form stories that evoke their own preconceived concepts rather than the researcher forcing their concepts on the interview [11, p.32].

We developed what we term ***futuristic stories***, questions of "How?" that are framed as stories which, in turn, elicit stories grounded in the roboticists' own beliefs and perspectives. Part of our inspiration for developing futuristic stories comes from the emerging methods of critical design in HCI (e.g., design fiction [65], storytelling [34], and future studies [40]) and scenario-based techniques in CSCW (e.g., scenario-based interviews [41, 72], scenario-based storyboards [39], and scenario-based questions [68]). These scenario-based techniques are often used for evaluating groupware systems or for understanding how users will behave and interact with prototype systems.

Our *futuristic stories* could be read as a similar method to scenario-based design or design fiction. Based on a literature review of scenario-based techniques and design fictions, we will highlight key differences with our method of futuristic stories. Unlike scenario-based design, our focus is on unfolding the designer's perspective instead of the user's and on exploring the design, social, and ethical implications of future technologies rather than problem-solving current technologies.

Although the definition of design fiction and its kin is not solidified [6], for some, stories used in design must fulfill the criteria of good fiction (e.g., character and plot development, distinctive voice). We emphasize that with respect to this criteria, our futuristic stories would not qualify to be called a literary work of "fiction". Our futuristic stories take up one paragraph, shorter than most fiction, so that participants could rapidly understand the imaginary future situations and contexts we presented. The objective was to elicit discussion from our participants on future research that extended their current research. We followed basic components of stories by incorporating actors, goals and settings, and dramatic elements to make stories compelling to interviewees [9, 17]. We pilot tested and iterated the futuristic stories at our local university.

The primary reason we call our method "stories" is our perspective on values. We follow JafariNaimi et al.'s [28] view on values as hypotheses "to examine what the situation is, what the possible courses of action are, and how they might transform the situation…values are not applied to situations; rather, values serve situations as hypotheses" (p.97). They also emphasized cultivating "stories" since when values are in stories, they can make explicit "what the situation is and what action it demands" (p.103). Values ground the decisions we make in situations. Thus, with our futuristic stories, we can examine how our informants see posed and evoked situations, and then map out possible actions. This behavior can help us indirectly understand the values roboticists have regarding their discipline and practices.

We developed several stories to observe how roboticists would configure their robot in response to different, future situations. These stories asked about unforeseen circumstances in the future, the moral and social impacts of robots, tensions with the public or government, the future roles of robots, their design philosophy, and their anticipated collaboration with robots.

We also created simple ***value index cards*** to evaluate the values roboticists prioritized over others. Each index card was labeled with a value-related word such as "safety" and "trustworthiness." We had an initial set of 15 cards (e.g., believability, transparency, expressivity, and safety). This set of words was derived from our previous study [12]; we identified prominent values that emerged within and across humanoid roboticists' interviews from robotic podcasts and YouTube videos. We identified the value words that served as hypotheses [28] for interviewees to act upon in different ways, which fits our notion of values in this paper. These words were then the values we used as hypotheses on our informants in this study. This initial list served as a jumping point [19] for roboticists to think and talk about values as well as create new values. The physicality of the cards allowed our participants to fully explore value cards (e.g., freely inserting, arranging, and ejecting cards in the list) and to select them carefully [20, 53]. Our cards were not rigorously devised to replace previous card methods. Rather, we used them as an expeditious delivery mechanism to fulfill our specific aims: discovering a set of values relevant to our interviewee's ideal robotics research (e.g., values which expressed the desirable form of robots and how these values were interpreted by roboticists).

We found inspiration from the Envisioning Cards designed by value sensitive design researchers Friedman and Hendry [20]. They developed a toolkit (value cards and scenarios) to remind designers of values in the design process. Unlike their cards, we did not use images in our cards; previous research has noted that images can confuse and bias designers towards particular interpretations [37].

We believe both our methods complement each other. Futuristic stories address roboticists' practices and perspectives while value index cards allow roboticists to focus on the artifact itself (the robot).

Interview Procedure

In our interviews, we employed the aforementioned futuristic stories. Participants were given six futuristic stories related to robotics one by one. In our prompt, participants were encouraged to freely use their imagination and creativity in their responses. Interviewees were then asked to respond to these imaginary situations and to create their own narrative on what might have instigated these stories. As with any semi-structured interview, we further probed their responses, asking interviewees to elaborate on their narratives. For example, we often asked how personal or research experiences influenced their narratives.

After each interview, time permitting (see Table 1), we asked our interviewees to do the value index card exercise. We intentionally implemented the card exercise at the final stage of the interview. By first talking about their values and reactions to our futuristic stories, informants were eased into considering how they would prioritize their values. Our roboticists were encouraged to choose and rank five of the value cards that best described a robot they would like to build. Roboticists were not restricted in how they did their rankings; for example, some roboticists thought some values would be ranked equally, and blank cards were provided to allow people to pencil in new values. These newly created value cards (e.g., adaptive, robust, usefulness, AI, joy, and honesty) were carried onward to the next interviewee. During the exercise, we encouraged interviewees to think aloud.

Analytic Approach

Our concern is in the ways roboticists consciously and subconsciously exert a particular viewpoint on the reality of robotics and its components, and in what way these viewpoints are indicative of the particular values these roboticists hold. Such realities not only shape what "proper" robotics is but also define what robotics is not. Our grounded theory analysis of texts is sensitized by this social constructivist perspective [11]. We are interested in the interviewees' construction of meaning and the social context of these constructions, not just explicating the social practices of our informants.

As researchers in the field of HCI and CSCW, we are also cognizant of how our own standing—the intention we have to be critical of the robotics field—may shape our analysis. User-centered design, for good reason, has investigated how users perceive and see values in robots. Yet, we know that designers have a particular construction on users that may be reified in their designs [69]. For example, Lazar et al. [33] suggests that normative views of older adults may creep into the designs of robotic pets (e.g., older adults as the socially isolated). Šabanović [54] notes that a technological deterministic view of robots limits the role of society in adapting and participating with these new technologies. These observations helped sensitize our analysis to how the experiences and training of roboticists are linked to values, and how these values are embedded in their design practices and philosophies.

Through the grounded theory method [11], authors first individually open-coded interview transcriptions. Codes were then repeatedly compared and discussed throughout several meetings to generate higher level of code units and their subcode units. For example, the parent code, "user belief," (a judgment by roboticists on the beliefs of users) consists of subcodes: trust too much (users trust robots too much), ambivalent (the roboticist is ambivalent about the user's beliefs), denounce (the roboticist denounces the user's beliefs), etc. Our finalized code book contains 13 parent codes (see Table 2) and 106 subcodes, and focuses on how roboticists construct their robots and users. Our findings turned out to be particularly grounded on the "the user," "user belief," and "tension" codes.

Parents Code	Description
robot as agent	Robot is described as having abilities or responsibilities beyond those of machine or object.
robot as mean	Robot is expected to do something like a tool or technology.
predictability	Whether or not what a robot does or its impact is predictable.
preternatural	Unique characteristics set a robot apart from a human, animal, or any existent being.
children	Children as HRI experimental participants or prospective users.
the user	(Future) user's responses or behaviors based on the roboticist's experiences or imagination.
user belief	Indicates a user's particular beliefs about robots.
tension	Tensions between different views and groups on robots.
ideal robot	Desired forms or features of robots that roboticists wished to build.
societal effect	The current or potential influences of robot (research) on society. Its social and cultural implications.
process	Research related activities (e.g., designing or engineering a robot) or a roboticist's individual research philosophy and approach.

Table 2. Parent Codes and their Descriptions

FINDINGS

Through the use of our futuristic stories and value index card exercises, we sought to lay bare the subconscious values of roboticists and their designs. We now detail how our roboticists constructed a notion of themselves, users, and robots. First, the roboticists' expertise allowed them to exert a privileged position of authority. Their source of knowledge stems from hands-on experience, especially in programming. Second, we show how roboticists perceived users in the current time differently from users in the future. Last, drawing from our value index card exercises, we explain what values were central to the roboticists' ideal form of robots. These values point to a utilitarian robot as the ideal robot among our roboticists.

Roboticists and Robotics

Hands-on Experience: The Authority of Roboticists

Developing a robot requires roboticists to not only obtain knowledge of the basic principles of science (e.g., physics) but actual hands-on experience constructing robots. This view shares some parallels with Greek philosophy's view of knowledge as consisting of two opposing concepts: episteme and techne, or scientific knowledge and craft [66]. Our informants took particular care to emphasize that the hands-on experience of real everyday practices (i.e., programming, building a robotic simulation platform, implementing a robot, etc.), the craft of robotics, was vital to anyone claiming to be a roboticist. As R10 says, this constitutes the "know-how" of robotics: *"For example…an airplane does not flap its wings. We've engineered through years and years of understanding the laws of physics. We've engineered a giant mechanical bird that flies without flapping its wings…It might be inspired by a bird in the sense that it is a flying creature, but it is something that doesn't exist anywhere naturally. We engineered it; we created it through our know-how."* R10 here emphasizes that although the laws of physics have informed the building of machines like planes, knowledge gained from engineering—crafting and know-how—is necessary.

Hands-on experience provides roboticists with the pragmatic knowledge to find bugs, new algorithms, appropriate programming platforms, and real world environments in which their robot can work: *"[Y]ou need to test your robot many times. You design [your robot] with other[s], and then the goal is to clear a task, and then maybe you try to program, or something like that. Then you test your robot. Then how good your robot is. I think for the first time they will be bad, but then you try to find a reason why, and make it better…until it is built…To deal with the real world is really difficult. [R7]"*

In our findings, roboticists emphasized that they themselves engineered their robots. By *doing* robotics via prototyping and lab experiments, roboticists iteratively gain the necessary knowledge to create robots. For example, R15 said, *"[W]e actually redesigned the three versions of humanoid robot in my masters degree. The first version, since we don't have the experience so that [a robot] design is actually is very bad. I implement my algorithms and the gait planning on the robot. It doesn't have a good effect, but the third version, since we have a lot of experience so it can move very faster and stable."*

In particular, having this complete knowledge of robots and their inner workings sets robots in contrast with humans: robots are fully predictable and controllable. For example, when presented with one of our futuristic stories asking about unexpected findings in the future, R1, who specializes in automation and cognitive robotics, remarked, *"I don't see a surprise with the robot in itself, because you make it, and it's a robot, it's a machine for you…you can have a lot of surprise because of the human, because [with] the human you cannot predict…[Y]ou design a machine, and you know exactly what is in my machine."* This belief in the robot's predictability is indicative that roboticists, with their holistic view of their discipline, had difficulty imagining the robot itself as the cause of surprise.

Moreover, the hands-on knowledge roboticists possess allows them to see the necessary *limits* on the abilities of the robot themselves. Most of the roboticists in our study (except R3,5,9,11) expressed skepticism that robots could ever go beyond their own knowledge or expertise: *"[Y]es, you can teach a machine to do certain things but you can only ever teach it about stuff that you know. [R16]"* And R13 noted, *"To surprise me it [a robot] would have to discover something that I didn't put in it."*

We argue that knowledge gained throughout this practical process of robot making authorizes roboticists to put forth strong claims about what a robot is and to form an optimistic, though particular, view on the future of robotics. One particular hands-on expertise that was highlighted by roboticists was programming.

Programming Skill as a Representative Expertise in Robotics

In all our interviews, programming was the representative expertise in robotics. Programming was characterized as a mechanism by which robots are ensured to work in a constant and predictable way.

Roboticists saw a programmed robot as a realization (output) of what they intended the robot to do. R23 notes that roboticists are "masters" of their robots and follows up with an unlikely scenario: *"Robots aren't going to take over the world unless you program them to take over the world. If you program robots to be enough like people that they'll want to start wars, then they'll want to start wars."* Similarly, R5, conceptualizes robots as just machines, albeit ones that reflect—via programming—their designers: "*[B]ecause these machines essentially represent the intentions of the people who have programmed them.*" Thus, programming explains why robots will never become evil, out of control, or disobey humans.

Although programming limits the scope of robots to what their masters allow them to do, roboticists do not frame programming this way. Instead, programming allows roboticists to "program" the future. Programming provides a pipeline by which future stories with robots can be optimistically realized. As viewed by roboticists, the possibilities are endless. More than half of roboticists imagined that a robot's personality (R4,5,17), morality and/or ethical behavior (R2,4,8,10,12,13,17,21,23), and thinking (R1,7) could inevitably be achieved someday by programming. R4 and R23 reinforce this idea that programming can create any number of futures with robots (open minded or ethical):

> You can program them [robots] to be very open minded. [R4]
>
> [Y]ou've got to program some kind of ethical behavior into them or have some way that they can respond to situations that require choosing one option over another. [R23]

Programming is a vital skill for our roboticists. More than a tool, programming allows roboticists to create robots without restrictions. Though some roboticists (R6,8,15,17,18,20,22,23) did not necessarily want to, they mused it possible to program and control robots to have more "abstract" qualities such as morality or personality.

Having established how roboticists construct themselves as authoritative creators and programmers of robots and their future, we turn to how roboticists construct perspectives on the users of their robots. In particular, we show how users are framed chronologically: the current, naïve user and the anticipated (inevitable), sensible user.

The Current and Anticipated User

The discourse of roboticists reflects both the current circumstances of our robotic world as well as a future, anticipated reality where robots inhabit our world. We show that when the discourse of roboticists was grounded in the current state of robotics, it constructed a view of users we call ***naïve users.*** Naïve users have a limited and intuitive understanding of robots. These naïve users simultaneously trust robots all the while expecting them to accomplish extraordinary things.

When looking to the future, roboticists anticipate naïve users will inevitably become what we label ***sensible users***. Sensible users understand how robots work, are smart consumers who are aware of how robots will satisfy their needs, and can operate the robot through sophisticated means (e.g., programming). When roboticists configure their users from naïve to sensible users, they also outline an agenda for their anticipated robots—the legitimate robots of the future. Here, these robots' designs match the expectations of roboticists that users will be sensible. We also see that sensible users mirror roboticists themselves whom are very aware of the limitations and possibilities of robots. These ideal robots are safe, functional, and expect humans to adapt to them in a way of treating them with dignity and respect. Again, both types of users involve an imaginary form of user to some extent since our roboticists reflected not only on actual users but on potential users. We now detail the current and anticipated user.

The Current User: A Naïve User

Fundamentally, these naïve users, the user of robots today, lack a deep knowledge of robotics. They cannot conceptualize the mechanisms that underlie how robots work. To cope with such a lack of knowledge, naïve users may unduly form strong, trusting attachments with robots. Like children, current users ascribe things to inanimate objects that adults know not to do. Lastly, naïve users have a high expectation of the robot's capabilities, beyond what a roboticist intended to program. This construction of the naïve user draws in part from the roboticists' experiences interacting with test users in their experiments.

Users in HCI or CSCW are sometimes regarded as laypeople with limited technical knowledge. As we discussed earlier, programming skills were positioned as the representative expertise of robotics. In alignment with this, when roboticists think of robot users, programming skill becomes the defining line differentiating themselves from users. In this regard, R21 explicitly notes, *"Generally the people that we deploy [to] wouldn't know how the robot works. I guess that's the distinction I'm making...To me it's just a machine and until that, it's intelligent enough."*

These naive users do not recognize the programming mechanism that operates robots; instead, they attempt to interpret the robot based on observations of the robot's behavior. Without an understanding of programming, for example, R7 mentioned that users, unlike roboticists, would misunderstand a robot. Specifically, R7 talked about how users with little background in robotics would perceive the movement of robots as free will:

> Oh, this action, it's natural, not programmed, or something like that. In that case maybe someone would think that this robot can think and act based on maybe the circumstance or something, the situation. For me, you just programmed it…it's not free will, of course.

This lack of knowledge of robots creates a naïve user who believes the robot "thinks" and adapts as humans or animals do in their environments. The roboticist, however, knows there is nothing natural about this—the robot is simply programmed.

In a similar vein, roboticists (R1,7,15,16,18,19,23) saw that naïve users generally have high expectations about what a robot can do. The naïve user tends to hastily assume that robots can go beyond the capabilities for which they are actually observed doing. R19 notes that people will imprint a human onto a robot:

> People have different expectations…because when the robot does something that seems like what a human does, the humans generalize that capability to other things. So if a human did what the robot did, then we would expect it to be able to do certain other things. But maybe the robot can't do those other things because people don't actually understand them correctly.

P16, drawing from his experience, also says, "*Generally people have very high expectations…they expect robots to understand whatever you are saying, probably they just expect robots to be exactly like humans, for some reason and a little bit better."* R20 talked about how health care users had unrealistic expectations of their robots: *"We gave them a health care robot, and they expected the robot to look after their health, but the robot didn't notice when they were ill with some infection or something, and they thought the robot should deal with everything."* A source of contention for roboticists is that users expect robots to be like humans and get upset if they do not fulfill these expectations which may come from popular media or a robot's human-like appearance.

Naïve users also envisioned a robot as "smart," having a range of abilities in terms of either intelligence or physical capacities. For example, R1 recalled a conversation with one of the test users in his experimental studies. Users were fascinated with mental and mobile tasks that were impossible for the robot in the study: *"[W]hen you speak of robot, to people that don't know this field, they all imagine…[a] robot, that [can] think, that can move, that can act."* He spoke of the innocent questions a user asked: *" 'Robot, can [it] clean the table?.' That robot cannot do it. They just can't. Robot are not smart, intelligent...But people, they believe it…that [it is] the case."*

Rather than intelligence, according to roboticists (R18,19), users tend to overestimate a robot's physical ability. For example, robots were expected to move heavy objects or accomplish tasks at a rapid pace. R18 noted, *"But it is quite normal, like every time that I take the robot to any school or to a demo…their expectations are quite high…It is not about intelligence and it is not about emotional intelligence. It is about the physical things."*

Naïve users also trust a robot by default (R2,10,13,23). R2 shared his experience with an experimental study involving these trusting users. He found that users unduly listened to what a robot said and complied without argument: *"[W]hat's surprised me is the people's willingness to follow what the robot tells them to do…I'll go with that [being surprised in the future], if an interaction user experiment found that people were still overly trusting of robots. [R2]"* Users are "*deceived"* [R5] (unintentionally) by robots.

As alluded to in the earlier example (e.g., easily ascribing things as living beings), the topic of children often came up as the exemplar of naïve users. Roboticists recognized that for children, robots could only represent joy. When R16 presented children with their robots, they "*wanted to see the robots dance, they wanted robots to tell jokes, they wanted robots to hug them. [R16]"* Children are consequently very trusting of robots. They view robots as their "*friends"* [R10] since children don't understand "*there are people behind [a robot]. [R1]*" People are not literally behind the robot but are instead responsible for a robot and its design, development, and manufacture.

Lastly, although users anticipated that a robot would be able to handle all sorts of work, like humans would, because of their ignorance, users were unable to grasp the dangers of such an all-purpose robot. R1 emphasized that naïve users do not recognize that an omnipresent robot might also be a surveillance device, always listening and watching a user: *"I can really say that…for people today, they don't care at all about privacy. But it's not an issue today because people don't know today that this robot [can] do that. [R1]"* Roboticists (R1,4,6,13) believed the issue of surveillance is especially problematic for children and older adults. Like children, older adults were deemed a kind of naïve users by R23, who pointed out that older adults could be, even if it happens accidentally, vulnerable to privacy: *"[I]t could be privacy perhaps in that your robot hasn't respected the privacy of the elderly lady or something."*

The Anticipated User: A Sensible User

In contrast to the naïve user, roboticists anticipated a new kind of user emerging in the future, a sensible user. Roboticists envisioned that naïve users would inevitably become sensible users. These sensible users would be capable of understanding and sensibly restraining their desires and preferences on when to use robots in their lives. In addition, sensible users are able to loosely understand how a robot works, at least far more than naïve users. R23's statement resonates with this sentiment. *"There's some robot researchers I've spoken to who will say, 'Oh, yeah, they [sensible users] would never treat a robot like a human because they've programmed it, they understand how it works*.' *"*

In a similar line, sensible users embody a certain prospect that users will inevitably garner technical skills for harnessing robots. Even children, despite their naivety, are potential sensible users. Based on their longitudinal observations of workshops and experimental studies with children, R10 commented that children are "*perfectly able to actually understand programming concepts."* R4 shared this positive outlook by adding that "[*W]hen you put the people [with no engineering background] to think about that [difficult robot programming], to spend hour on that, on those things, they will find a solution."*

Interestingly, some roboticists (R1,10,14) explicitly predicted a future in which the sensible user is one who adapts to the needs of the robot, rather than vice versa. R10 was confident of this prediction: *"I think the robot will absolutely have to violate some of your expectations, some of your social norms, in order to function. I am perfectly convinced that people will be completely fine with it."* Such users were envisioned to be willing to overlook any mistakes conducted by robots.

To illustrate this point, R10 describes how the sensible user must let a robot be a robot. The robot may optimize its functionality (movement) by ignoring humans: *"How it works is that people want the robot to [physically] be right here and I'm [the roboticist] telling you the robot works best if it's right here…What it [the robot] is doing in that sense is it knows what the person wants but it is actively making a decision not to do that and to instead sort of maximize its own performance. [R10]"* Significantly, the ideal robot (and by logic, the roboticist) knows best—or it knows better than the user. R14 stated that users would adopt a "robot language" when talking to a robot: *"You say to the robot, 'Make me tea,' but you'll do that in the robot language, which you'll probably say, 'Make tea. Make this human tea.' "* A sensible user knows that a robot rightfully demands dignity and respect from its users. They accept the robot's inability to follow human social norms.

Following this thread of users accepting robots as they are, roboticists (R1,2,10,12,15,18,20) also viewed sensible robot users as *smart consumers*. That is, in the future, if robots are purchased, users will recognize all the trappings that naïve users may have with robots. *"If it's, for them, bad to have a robot, they will just not buy a robot, and then a robot will not start being on the market. If there is [a robot on the market], then [it] is because people want it. I think people wanting [it means that]…they agree that probably you create attachment [with the robot]. [R1]"* That is, if a user is a smart consumer, they will realize that a robot may not fulfill certain expectations; a robot will need the user to adapt to it (rather than vice versa), and a robot may fool one into believing it is trustworthy or intelligent (i.e., the smart consumer is willing to become attached to the robot and buy that fantasy).

R1 believes this scenario is likely because humans will discover the sheer, inescapable advantages a robot provides. R1 said, *"[M]ost of the time, people that use this technology, they kind of agree, they like it, they buy because they find that the advantages are more important than the disadvantages. [R1]"* Therefore, the sensible user is willing to adapt to the robot for its advantages; the robot need not adapt to the user. Resonating with this, R10 emphasized that roboticists should understand how people adjust themselves to gain the benefits of technology like they did with personal computers, and roboticists should embrace this idea by exclaiming that "*robots have needs too.*"

The Ideal Robot: A Utilitarian Robot

We had fifteen of our roboticists (see Table 1) do the value index card exercise (the remaining eight participants we interviewed were unable to participate due to time constraints). Through this card exercise, they were able to expound their views on a desirable form of robot and its values. We report on the set of core values participants chose as most important for a robot. Useful/has a purpose (selected by 11 people), safety (9), reliability (9), adaptive (7), robust (6), trustworthy (5), and friendly (5) were the values most consistently picked. These values were also found in our interview data employing our futuristic stories and were triangulated with our codes. In reporting our findings from the value index card exercise, we will draw from relevant quotes that illustrate why roboticists picked particular values as important for their ideal robot.

Usefulness was the most dominant value. Within this category, we identified various dimensions in interpreting the value of usefulness: being well-functioning, beneficial for humans, and under the control of users.

The robot's functional ability was often prioritized above other components of the robot. For example, one roboticist valued a robot's performance over its appearance, saying, *"Oh, it doesn't matter what it looks like, just that the robot does something. [R20]"* Similarly, a human-like appearance was not an important component for R10 who noted, "*I focus on how it moves and how it communicates rather than what it looks like*." R10 continued to mention directly that sacrificing users' demands could be allowable as long as a robot does its tasks successfully: *"I consider robot performance rather than strictly considering human preference. Instead of looking at the system as either making you happy or making me happy, you look at the system as being this [a system] and you want to maximize the overall objective performance of this system."*

Functionality was also connected with a robot's efficiency. For R16, the economic efficiency and work productivity of a robot were the most important goals in developing a robot: *"The goal is that we want to make the robot to help us to do the work more efficiently. Like in a factory, maybe it's in [the production] line that you need maybe five or four-hundred workers. For robots, maybe you just need one-hundred. They're efficient. They're advanced, they're much, much, more better. [R16]"* Moreover, the value of usefulness seemed to rely on how well the robot met human demands and the needs of the occasion. In this sense, a useful robot is implicitly related to a user's values. R21 believed that people would foremost pursue a useful robot: *"If it provides use…If people find them useful, then it's really good. So, people like them very much because they're useful, right?"*

In line with functionality, an ideal robot is a robot that is predictive and understandable: "*What I really like with robots is they are machines, and by a sense, machines are predictive, you can understand, you know what will happen, and that's really the positive robot, is that it's a machine, so you know what will happen [R1]."* This matches with the roboticist view mentioned earlier that their robots are predictable.

Next to the value of usefulness, *safety* was identified as the second most important core value. The value of safety was closely linked with functionality. For example, R17 said, *"It [an ideal robot] should have a purpose, so what's the main purpose of that particular robot? It should be safe and it should be physically capable of doing certain roles."* Although our interviewees handled safety mainly from a physical perspective, safety can also mean psychological safety. For example, this kind of safety could be fulfilled by eliminating any misinterpretation of the capabilities of the robot. R13 said, *"I think that it's important when designing robots that you're very careful about discouraging emotional bonding. You want to handle the risk of emotional bonding with care. I don't think that robots should bond with humans. They should be designed to be straight and correct but not friendly."* R13 here defines a "straight and correct" robot design as one that limits user-robot bonding. R13 continued to talk about the need to protect children's psychological state: "*It could be the robot has caused some kind of psychological damage like my children are upset because the robot…is taken away because they bond effectively with the robot*." Again, safety from a physical and psychological perspective as articulated by our informants lines up with our earlier discussion of naïve vs sensible users. Robots should be designed to discourage users from adopting behaviors indicative of naïve users.

Overall, our findings show that the ideal robot, as constructed from a roboticist's perspective, is a utilitarian robot. Such an ideal robot fulfills the needs of sensible users and roboticists.

DISCUSSION

In this section, we first describe our work's connection to CSCW and its ancillary disciplines (HRI and HCI). We highlight several opportunities for CSCW to reconsider the underrepresented role of *roboticists* in fieldwork and user studies. Second, we consider where roboticists have potentially ignored *users* and imposed their own perspective, a potential violation of the user-centered and participatory design tenets of CSCW. Third, we advocate for methods to have users involved with roboticists in more egalitarian settings where expectations of both users and roboticists are mediated. Last, we argue that power to determine how users should or will behave may subjugate particular groups of users as well as roboticists.

Why Roboticists Matter in CSCW

In past CSCW studies that have overlapped with HRI (Human-Robot Interaction), there has been relatively little work examining in-depth the perspective of roboticists. There certainly have been fragmentary glimpses of what roboticists think of their study participants and their actions [32, 36, 38]. In a study on robot interaction with museum visitors [32], roboticists similarly had a discourse describing users as naïve users. For example, users failed to realize "the robot was controlled behind the scenes" [32, p.202] and had a hazy idea of what existing robot products could do [38].

In addition, most robotic studies in CSCW have not focused on the changing attitudes of users over a lengthy period of time. Instead, studies typically describe either a user's first response or a user's impression of a robot at one single moment of time. One exception is Ljungblad et al.'s [38] study in which hospital staff were exposed to robots for nearly two weeks. They found that, depending on a staff member's previous familiarity with robots, their perspectives changed over time from the negative (e.g., concern over the robot's safety and reluctance to give room to the robot in the workplace) to the positive (e.g., feeling comfortable with the robot and describing them as "cute" or "clever"). Staff also began to see the robot as an alien, a worker, and colleague once they got used to it [38].

Set in contrast to our findings, Ljungblad et al.'s result is fascinating because our humanoid roboticists generally felt the exact opposite. That is, the discourse of roboticists echoed the view that as users became more familiar with a robot, they would begin to see it, as sensible users, for what it "truly" was—as programmable machine or tool. This viewpoint, skeptical of a social robot (from a naïve user point of view), is all the more interesting when we are reminded again that our informants were all roboticists at the HRI conference, a leading conference precisely tasked to think about the user in human robot interaction. One might expect such participants to have a perspective on the future of robots more aligned with findings from CSCW.

The scarcity of work elucidating the roboticist perspective and the potential conflict between what users and roboticists think suggests that we ought to rescue, or make visible, the roboticist view. That is, rather than discount our findings as misunderstandings of users from roboticists, we should investigate further whether roboticists have a point. Future studies may investigate the predictions of roboticists on how users will evolve with robots. Previous studies [32, 36, 38] have recruited participants regardless of their previous exposure with robots. In designing future studies, however, we need to take the beliefs of roboticists seriously and scrutinize the effect of robot exposure on a user's perception of robots.

Case in point, the roboticist viewpoint on users provides a potentially new avenue to reexamine the meaning of users. Designing for naïve or sensible users posits a user stuck in time. The ideal robot is also a robot that meets the user in their most "advanced" state. Instead, we ask, "Might the robot user be reconfigured as existing in a transitional stage between naïve users and sensible users?" Furthermore, if the user is in transition and if this transition is desirable (as it is for roboticists), then we can also ask, "How should we design a robot for this user in transition?" Or, "How can we design a robot to encourage this transformation?" If roboticists wish to see sensible users who can appreciate their ideal robot in the future, roboticists need to find ways to help users to move forward to be sensible users. To present one concrete example, robots could be devised to remind their users transparently what functions are available or not when users exhibit interaction behavior that matches a naïve user. This also implies that robots need to perform differently for different users; robots can act depending on where a user is on the spectrum of naïve vs sensible users. In sum, our work suggests a broader question regarding users: who is a future robot for? How can the robot support all sorts of users or only a limited range of users? If so, how should the robot work differently for each level of user?

Lastly, given the backdrop that roboticists may design their robots with sensible users in mind, we need to reevaluate why users may behave a particular way with robots. For instance, if a hospital robot is shown to be unsociable, that may be the intent and desire of the roboticist. Future studies need to investigate how robots are (stubbornly) designed for only sensible users; that is, the user must work to respect the robot and its needs to gain maximum worth.

Why Users Matter in CSCW

CSCW has long focused on how those in the organizational "trenches" have or have not adopted technology. It can be said that CSCW is sympathetic to user-centered design (UCD) approaches and, later, participatory design approaches that de-privilege designers and researchers. Ackerman notes that we "should not force users to adapt" [1, p.191]. However, the discourse of roboticists seems at odds with this CSCW mantra.

Most technologies have taken for granted that their end users are novices, and technology designers and developers often see themselves as wholly separate, different actors from their users because of their expertise. As a result, interfaces focus on being intuitive and easy to grasp on first glance. For example, children are often able to use tablets instinctively more than adults because its design is focused on novice users, such as by having intuitive gestures like swiping the screen with fingers [43].

However, despite the view of the "novice user" as the target user to design for, there is also a strong belief that technology designers should consider expert users, so-called "power users" [29, 31], in HCI. Our study found that roboticists envisioned future users as something analogous to power users. This notion of the future user as power (sensible) user *mirrors* the roboticists themselves. In our interviews, future users were described as users fully cognizant of their preferences and measured in their expectations, respecting the robot's programmed-nature. Roboticists spoke of themselves as if they were future robot users. By stepping in as *the* future user, roboticists, the sensible users they are, ensure that people finally would adopt a robot in their life and adapt to it—respecting and admiring its achievements (and, by logic, admiring the achievements of the roboticists themselves). This form of user—the evolving user—is rarely discussed in CSCW and HCI [15].

There has been less attention focused on how designers react to people's use of their designs; more specifically, there is not much reflection on whether a designer's original design intentions were successfully interpreted by users. The ideal robot configured by roboticists leaves little room for incorporating users' preferences, behaviors, or values. As we have discussed, roboticists choose several core values for their ideal robot: a well-functioning and safe (for users) robot that has a purpose. These are values that rely on a robot's built-in technical ability and function. Moreover, whether these values are successfully realized fundamentally depends on a roboticist's technical capabilities rather than the user's. Such engineeringoriented values [13] do not come from interactions or relationships with users nor require an understanding of what users want. This utilitarian viewpoint of robots precludes the need for fieldwork or user experiments.

Reconciling future users and (ideal) robots with the roboticists themselves may conflict with the tenets of UCD because it makes strong a priori assumptions on the needs, preferences, and behaviors of users. A perspective of users as naturally sensible users or roboticist-like may severely limit the sort of users robots are made for. If robots are only accessible via their design to those with a background in programming or engineering, we may end up marginalizing people due to their socio-economic background. If robots are to be deployed in organizations, limiting their design for sensible users may privilege and reinforce hierarchical structures [60]. Certainly, the mismatch between intended users and actual users has canonically been a key factor for the failure of technology adoption [24, 48]. For naïve users, robots that simply achieve good functionality might not be good enough to also meet the high expectations they have of a robot's capabilities. Moreover, robots designed for sensible users may actually reinforce that robots are for the elite or educated (which may mirror the status of many roboticists who come from elite institutions).

A Solution?: UCD and PD in Robotics

Our findings suggest that roboticists and designers—those whose jobs are to anticipate the future—need to make transparent what forms of future users they desire in their design processes. Methods such as those from Briggs and Thomas [8] may achieve this transparency. They detail a study on the costs and benefits of different designs across a whole range of different users (older adults, unemployed adults, etc.); they use a design phase that involved inclusive focus groups revolving around futuristic technologies. While not involving the researchers or designers themselves in these focus groups, we can envision that an approach to robotics utilizing their method but also involving roboticists themselves would be fruitful.

Questioning UCD and PD in Robotics

Yet we also acknowledge that roboticists can never leave their biases behind when designing or developing [51]. For instance, as Neven [46] showed, opinions and views of test users were easily neglected by designers. In that study, because of the preconceptions designers had on older adults as feeble and passive, the active and healthy qualities of older adults were rarely reflected in their robot designs. This was even after designers followed good user-centered practices by conducting contextual inquiry at the homes of users.

Certainly, the roboticists in our study *were* aware of their own biases as designers. In this sense, R23 said, *"[W]e do so many things unconsciously that we don't even realize. We have so many unconscious biases."* If we accept the difficulty in examining potential the needs of users without our own biases, in what ways can we envision future users and critically see how roboticists configure users?

Moreover, if users are a heterogeneous group and designers will inevitably reject other perspectives and return to their own, the mantra of user-centered design (UCD) to configure the "user as everybody" [49, p.30] may be untenable. Yet, we should not consider the beliefs of roboticists to be inherently opposed to the principles of UCD. Rather, we should make their beliefs a part of UCD by respecting their point that all users are evolving.

Participatory design (PD) could be achieved in a way that encourages roboticists to be involved in a *redesign* rather than a co-design with users. This would be an attempt to gather user feedback after designs are deployed and in the actual usage by the public instead of during the design stage. Practically, it is difficult to rapidly prototype the mechanisms of robots according to what users want in the design process; after all, as our roboticist informants emphasized, building a robot is the fruit of learning basic science and experiencing hands-on practices over years. In addition, roboticists have difficulty understanding the actual demand for robots outside the lab setting since users do not typically own technologies like robots. Roboticists will be unable to receive helpful feedback until their robot is delivered to their actual users and used in the real world.

Involving users in the design process via PD has been discussed in social robotics and HRI [54] as a way to de-privilege the designer and elevate the ideas, needs, and preferences of users. However, we argue that user involvement should not be just about reflecting on the perspectives of both users and designers, but of *adjusting both their expectations on the abilities and benefits of robots*. Such PD sessions may draw lessons from how sponsors and Kickstarter campaigns successfully or do not successfully meet each other's expectations [56]. This resonates with a slight modification of Woolgar's insight [69] that "configuring occurs in a context where knowledge and expertise about users['] [expectations] is socially distributed" (p.61).

LIMITATIONS

We acknowledge that our study has limitations. First, we cannot claim that the HRI roboticists who participated in our study are representative of roboticists in general. Our participants were from a wide arrange of research disciplines in robotics from engineering to ethics. However, we believe this multiplicity accurately represents the diversity within the HRI academic community and other roboticists who are concerned with how their creations will interact with people. Second, our interview data only captures a snapshot of how roboticists think about users today, future users, and ideal robots. Their perceptions may reflect their current position (e.g., graduate student versus senior researcher), research practices (e.g., developing commercial robots versus robots in academia), or research discipline (e.g., speech recognition versus computer vision). Our findings did not differ markedly across these factors.

CONCLUSION

We have painted a picture in which roboticists vested in the human side of robots conceptualize users as in a transition from a naïve to sensible state. These same roboticists do not view their ideal robot as a machine that must become socially intelligent for users. Rather, users must accept robots for what they really are and how they really work. This sensible user is a reflection of the roboticists' own authority gained through both practical experience and scientific knowledge.

Rather than dismiss the beliefs of roboticists, however, future studies should incorporate the a priori "hypotheses" roboticists have on current and future robots and their users. We ought to examine how these hypotheses have affected the design of robots and, therefore, affected how users interact with current robots. We also need to be mindful that the power to impose beliefs can lead to robots that do not benefit users or are only available to the privileged.

We also proposed highlighting the expectations of stakeholders in egalitarian spaces for redesign to help mediate disparate discourses on robotics. Our desire is that this paper may help people both concerned and hopeful about the future of robotics by sensitizing the design of studies to the ways in which we all—implicitly and explicitly—configure users every day.

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