More Than Binary: Transgender and Non-binary Perspectives on Human Robot Interaction

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ABSTRACT

Research has shown that gendered robot designs prompt users to carry their gender biases into human-robot interactions. Yet avoiding gendered designs in human-robot interaction may be infeasible, as humans readily gender robots based on factors like name, voice, and pronouns. One solution to this challenge could be to use an intentionally *agender* robot design. Yet it is unclear whether trans, non-binary, or otherwise gender nonconforming people would view this as a positive and inclusive step, or as appropriative or otherwise problematic. In fact, little is known about trans and non-binary perspectives on human-robot interaction, which have not been previously studied. In this work, we thus present the first study of trans and non-binary perspectives on robot design, with a particular focus on perceptions of robot gender and agender robot design. Our results suggest that trans and non-binary users readily accept robots depicted as agender, and view this as a positive design strategy that could help normalize non-cisgender identities. Yet our results also highlight key risks posed by this design strategy, including risks of backlash, caricature, and dehumanization, and show how those risks are shaped by political and economic factors.

CCS CONCEPTS

• **Human-centered computing** → *Human computer interaction (HCI)*; • **Social and professional topics** → **Gender**; • **Computer systems organization** → **Robotics**.

KEYWORDS

Gender, Robot Design, Non-binary and Trans Perspectives, Human-Robot Interaction

1 INTRODUCTION

In this work we present the first exploration of trans and non-binary perspectives on the design of interactive robots. No prior work has explicitly sought the perspectives and insights of these
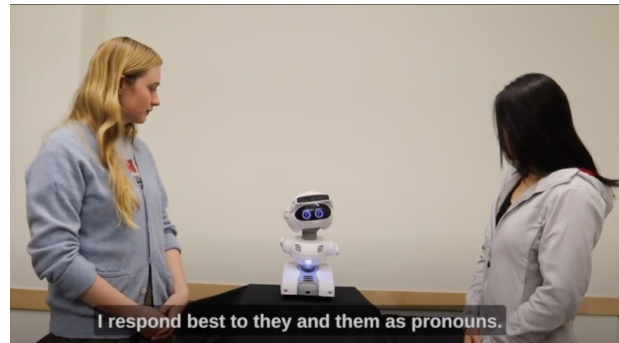
Figure 1: Still from the second of two videos shown to participants, depicting the agender robot Wynn.

communities, despite the ongoing debates in the Human-Robot Interaction (HRI) community on the feasibility and appropriateness of gendered vs non-gendered robot design.

While designing robots to be overtly masculine or feminine can lead them to be viewed more positively in certain use contexts, recent research has also shown that gendered robot designs prompt users to carry their biases and stereotypes from human-human interaction into human-robot interactions. Specifically, Jackson et al. [24] showed that interactants prefer "harsh" responses to norm violations from masculine robots, but disprefer the same responses from feminine robots. As Jackson et al. [24] argue, these results suggest that designing robots to be gendered in ways that optimize for usability metrics like "likability" will produce robots that most closely adhere to problematic gender norms.

Findings like these have led some to suggest we simply avoid designing robots that people will gender [50]. Unfortunately, recent evidence suggests this is likely not possible [40], as people are exceedingly quick to gender robots off of the barest of cues: the color of a robot's lights, the timbre of its voice, the bent of its name.

We wonder, though, whether this supposed paradox (whether or not to gender) stems from the cisgender perspectives that undergird much of contemporary HRI. Most work exploring gender in HRI has compared perceptions of overtly feminine and overtly masculine robots, and/or compared the perspectives of cisgender men and women. That is, gender in HRI is overwhelmingly examined through a cis-binary lens, with little attention paid to transgender and non-binary perspectives [26, 35, 38, 39].

This cis-binary perspective is inherently limiting. On the human side, this perspective excludes individuals who do not conform to hegemonically traditional notions of gender: people who not only

have unique perspectives on gender and the breadth of ways to exist as people but who moreover, per Standpoint Theory[11, 21, 22], may be best positioned to productively comment on issues of gender in robot design and to predict the risks and benefits of different approaches to gender in robot design. Non-cis individuals face extensive discrimination and violence [1, 16], and over 500 anti-trans bills have been introduced in the United States alone [44]. In robotics, the cis-binary perspective similarly excludes robot designs that are not located at the traditionally envisioned masculine or feminine "poles" of gender, yet nevertheless fall within human gender's multi-dimensional canvas of possibilities: such as genderfluid, pangender, demigender, bigender, non-binary, and agender designs.

In this work, we begin to explore the perspective of trans and non-binary users on *agender* identities in robot design. In doing so, we are not interested in the ontological existence or non-existence of robot gender, but instead focus on the *social negotiation* of gendered designs with regards to representation. While many robot designers have sought to make their robot designs mechanomorphic and "genderless" [50], this differs in nuanced yet fundamental ways from humanlike agenderness. Humans who identify as agender do not conform to masculine *or* feminine norms and expectations, and do not fall "between" masculinity and femininity. But this lack of self-identified, performed, and/or perceived masculinity and feminity nevertheless falls within the manifold of human gender and should not be equated with the mechanomorphic, objectified, "genderlessness" of traditional robot design. We thus consider whether a robot (Fig. 1) designed to *depict, and be perceived as, a character with an agender identity* (cf. Clark and Fischer [9]'s Depiction Theory) rather than designed to be implicitly "genderless", and which thus aims to *subvert* rather than merely *avoid* traditional gender binaries, would be readily accepted as such, and perhaps even more successful at avoiding ascriptions of masculinity and femininity.

Moreover, in this work we seek to understand how such designs would be understood not by a convenience sample of engineering undergraduates, but rather by trans and non-binary users most well positioned to comment on such robots' design and most likely to be personally impacted by such robots' use. This is particularly important as it is not clear whether trans, non-binary, or other gender nonconforming people would view agender robots to be a positive and inclusive step in robot design, or whether they would view them as appropriative or otherwise problematic.

To resolve these tensions, we performed semi-structured interviews, grounded in videotaped robot enactments, with ten trans and non-binary individuals. Our results suggest that our interviewees readily accepted robots depicted as agender, and viewed agender robot design as a positive strategy that could help normalize non-cisgender identities. Yet our results also highlight key social and political risks posed by this design strategy, including risks of backlash, caricature, and dehumanization, and show how those risks are shaped by political and economic factors.

Terminology

Before proceeding further, let us briefly define key terminology, using the definitions from the "HCI Guidelines for Gender Equity and Inclusivity" [37], re-presented here verbatim:

Transgender refers to an individual whose gender differs from the one which they were assigned at birth.

Non-binary identities do not align with binary conceptions of male and female. Non-binary individuals also do not identify with the gender they are assigned at birth, thus are often considered to fall under the larger "trans umbrella." However, some non-binary individuals do not identify as trans. Non-binary individuals may refer to themselves as **Agender** (not subscribing to any gender).

Cis-gender refers to an individual whose gender reflects the one they were assigned at birth.

2 BACKGROUND

There has recently been renewed interest in issues of gender within the HRI community, with researchers increasingly leveraging perspectives from feminist studies and gender studies [47] to critique how robots are gendered by design [35, 38, 39], how robots gender others [45], and how robots can subvert gendered expectations [17, 46, 49], as well as broader issues of who is (and is not) considered and included in HRI research [47].

While HRI has considered the role of gender in robot design for some time, most research in this space still falls short when it comes to explicitly recorded transgender and non-binary participation. Based on the research of Seaborn [38, 39], Winkle [47], and Perugia [35], there appears to be a striking lack of reported participation from non-cis individuals in HRI studies.

Evidence from Winkle et al. [47], for example, clearly demonstrates low levels of non-binary participation in HRI studies. This is perhaps unsurprising due to the low proportion of trans and non-binary individuals amongst the population that researchers typically sample, and due to the risks of patriarchy-driven and heteronormativity-driven violence faced by those who publicly identify themselves as trans or non-binary [28, 33]. Nevertheless, transgender and non-binary participation in even gender-oriented HRI research does not seem to approach the approximately 5% of young adults in the US who now say that the gender assigned to them at birth does not match their gender identity [5].

This presents a critical challenge for HRI researchers, as many HRI researchers are seeking to avoid ascriptions of gender in their robot designs – without consultation from agender, trans, or non-binary humans. As Katta Spiel writes,

> "[N]onbinary perspectives have to be included in research about us to make it relevant and appropriate to our existences. When researchers design technical systems in a fashion that actively excludes the discussed community from consideration, we call that poor design. It is thus confusing why the HCI community raises no such red flags when researchers make proposals about non-binary people without including us." [41]

Yet despite such calls for action, no prior work has considered the perspectives of trans and non-binary people on robot design, and even within the broader HCI community work considering trans and non-binary perspectives is still exceptionally rare [20, 27, 36]

Even research on LGBT+ perspectives on robotics are quite rare, with most of the few studies mentioning LGBT individuals seeming to consider their perspectives only on explicitly sexual grounds. Dudek and Young [14], for example, suggests looking to

the "2LGBTQIA+ community" for direction on the design of sex robots. Similarly, González-González et al. [19] mention a sex robot named "Harmony" that comes with transgender "options": a perspective that risks fetishization rather than inclusion of transgender people. This is not to say that considering the sexual expression of non-cis individuals is inherently negative. Rather, we argue that the field of HRI should be wary of only including non-cis people in design processes when it comes to matters of sexuality. Like all people, non-cis people have full lives that extend well beyond sexual preference and gender (non)conformity, with unique lived experiences that stand to inform critical research and design questions.

To address this critical research gap, we present the first investigation of the perspectives of non-cis individuals on robot design. To narrowly focus our investigation, we specifically consider the perspectives of non-cis individuals on agender robot design.

3 METHODOLOGY

To understand non-cis users' perspectives on agender robot design, we performed a semi-structured interview study centered around interviewee responses to videos of two short robot enactments involving an agender robot named *Wynn* and two cis-women, filmed at Colorado School of Mines.

3.1 Agender Robot Design

To give our robot an explicitly non-binary, agender, animate design, we used a careful combination of morphology, name, and voice.

Morphology — For our physical robot platform, we chose to use the Misty II from Furhat Robotics (Fig: 1). Misty is a small, toy-like robot with semi-anthropomorphic morphology (head, arms, and wheeled base) and semi-anthropomorphic surface features (eyes only). The Misty II was chosen to avoid morphological cues directly indexing of masculine or feminine gender. Furthermore, we believed that the moderate level of anthropomorphism would allow for a better communication of agender status given previous research suggesting that highly anthropomorphized robots are more likely to be gendered, and non-anthropomorphic robots are less likely to be perceived as capable of being gendered [34].

Name — We chose the name *Wynn* for the robot, as this humanlike name is suitable for both men and women, yet is sufficiently uncommon as a given name that participants would be unlikely to know someone of a particular gender that shared that name.

Voice — To give Wynn a voice that would not be clearly gendered as either masculine or feminine, we took the default feminine (semi-mechanomorphic) voice available on the Misty II and pitched it down so that it sat in a more gender-neutral range, following the guidelines presented by Danielescu et al. [13].

Pronouns — We had Wynn use (and communicate their use of) They/Them pronouns, as pronouns are a key way by which humans communicate their desire to be gendered in particular ways. However, as described later on, Wynn did not *immediately* volunteer this information.

3.2 Research Questions

Using Wynn, we sought to answer five key research questions:

- RQ1: How do members of the non-binary and trans communities generally make sense of gender in robot design?

- RQ2: How do members of these communities specifically make sense of robot pronoun use (and what pronouns would they prefer for agender robots to use)?
- RQ3: How does considering pronoun use change how members of these communities make sense of gender in robot design?
- RQ4: What ethical risks do members of these communities see for cis-binary robot design, agender robot design, robot pronoun use, and other design choices, especially regarding authenticity and appropriation?
- RQ5: How do the answers to all of these questions depend on robot embodiment and the intended context of use?

3.3 Recruiting and Participants

To answer our research questions, we recruited 10 transgender and non-binary individuals for semi-structured interviews. Participants were required to reside in the United States and be 18 or older. Due to the nature of our target population, participants were identified using snowball and peer group recruiting through personal, ally, and LGBTQ+ organziation (PFLAG) connections.

Self-reported demographics are listed in Table 1.

Age — Participants ranged in age from early 20s to mid 40s and lived in various different regions across the US, spanning both coasts, and from both the US North and the US South.

Gender — Participants were predominantly trans-women/femme, with limited trans-man/masc and non-binary participation due to snowball sampling network effects. This serves as a key limitation of our experiment, as there are key differences in lived experiences between trans men, trans women, and non-binary people.

Race — While we did not explicitly track participant race, the participant group was predominantly racialized as White, likely due to our sampling methodology (cf. [15]).

ID	Age	Gender Identity
P1	33	trans-man
P2	39	non-binary
P3	30	trans-woman
P4	40+	trans-woman
P5	23	trans-female
P6	29	trans-female
P7	32	non-binary, trans femme
P8	45	MtF transgender
P9	23	non-binary, feminine
P10	27	trans-femme

Table 1: Participant Demographics

3.4 Procedure and Interview Structure

Recruited participants were interviewed over Zoom. After providing informed consent and completing a demographic questionnaire, participants participated in a semi-structured interview that was broken into two parts. Each part began with the participants watching a short video enactment involving Wynn, and was followed with a semi-structured interview centering on that video enactment.

In the first video enactment, participants observed a brief introduction to Wynn describing potential contexts in which it could be used, and demonstrating some of its interactive capabilities. During this video, Wynn's ostensible gender was left as vague as possible,

with no pronouns used in reference to it at any point. After watching the video, the participant was engaged in a brief semi-structured interview, with predetermined questions designed to probe how and why participants may have gendered Wynn (Appendix A).

In the second video enactment (Fig: 1), participants observed a more in-depth promotional scenario, in which a salesperson presented Wynn to a prospective client (a hotel manager). This video actively described Wynn as agender, and used They/Them pronouns for Wynn. After watching this video, the participant was engaged in a more extended semi-structured interview, with predetermined questions designed to probe how and why participants may have gendered Wynn after seeing this extended enactment, as well as questions designed to probe perceived appropriateness around pronoun use, the use of gender in robotics, and the overall social and political benefits and risks of robotics as a whole (Appendix B).

3.5 Analysis

Participant interviews were transcribed and anonymized, then destroyed to protect participant anonymity. Transcripts were analyzed through a grounded theory approach [8], using the Dovetail software for qualitative analysis. We began by performing open coding to associate unique tags with the most basic meaningful phrases and observations from interviews. We then performed axial coding, by clustering open codes into higher level tags, and then further clustering those higher level tags according to a small number of central themes. This process was highly iterative, with coding unfolding over multiple passes.

3.6 Positionality Statement

Before presenting our results, we would like to acknowledge that while the lead author identifies as non-binary and Queer, the second author is a cisgender, heterosexual man; Both authors are racialized as White, and the authors study and teach (respectively) at a predominantly White and predominantly male engineering university. As such, the authors and their White participants have certain advantages and privileges that inherently limit the depth and generality of the insights drawn in this work.

4 RESULTS

Our qualitative analysis revealed five major themes, surrounding participants: (1) sense-making of Wynn's gender, (2) perspectives on intentional gendering of robots, (3) hopes for the long-term societal impacts of agender robot design, (4) fears for the potential harms that agender robot design could have for the trans and non-binary communities, and (5) considerations of political and economic factors that could mediate these risks and benefits.

4.1 Making Sense of Wynn's Gender

Three key subthemes emerged surrounding participants' perceptions of Wynn's gender: (1) participants' initial impressions, (2) changes in participants' impressions after overt indication of agender design, and (3) participant perspectives on Wynn's pronouns.

4.1.1 Initial Impressions. In the first semi-structured interview, both non-binary and transgender participants were split on Wynn's gender. Four participants perceived Wynn as masculine, four as

agender, and two as somewhere "between" masculine and agender. Participants who viewed Wynn as masculine attributed this to the pitch, timbre, and intonation of the voice:

> *P6* — "I would argue that because it has a more masculine dominated or masculine sounding voice, it could be argued it's male."

> *P8* — "[Wynn seems] male because that would be the sort of social assumption given the timbre of the voice."

This echoes prior work describing the difficulty of designing genderless robot voices [13], and the extent to which interactants readily use voice to infer gender [7]. Other participants viewed Wynn's name, eye color (blue), and speech patterns as masculine:

> *P3* — "[Wynn] was projecting a kind of confidence that in our society is considered unseen in women. Which isn't to say that women don't display that sometimes, just that, you know, the consequences for us will be different than they would be for a man saying that."

On the other hand, some participants used Wynn's voice, in conjunction with its morphology, to infer an agender or non-binary identity.

> *P10* — "It kind of has a neutral-ish voice and completely inhuman shapes. It vaguely resembl[es] the shape of a human, but in a cartoon stylized way that does not communicate anything as far as gender is concerned in my mind."

> *P1* — "[Wynn] kind of reminds me of the toys that were like from the early two thousands..."

These perceptions align with previous work that showed difficulty conveying gender neutrality [39], and with previous observations of how humans tend to gender other toy-like robots [43]. On the other hand, even from these first impressions, some participants showed qualitatively different views of gender than those described in previous work with cisgender participants:

> *P1* — "I would probably either go agender (a lack of gender) or non-binary, because there's nothing at least visually or distinctively in the voice or the tone that makes me think or assign a gender that would be in a typical binary. So for me that's, where my brain goes... *a robot is non-binary or agender because it is based on the way that I interact with it.*"

For this participant, who did readily perceive Wynn as agender or non-binary, this ascription was based on a view of gender not as something that is innate to or even designed into the robot, but rather as something that dynamically unfolds through interaction. These unique perspectives on robot gender were voiced even more broadly by participants after viewing the second video enactment.

4.1.2 Changes in Impressions After Overt Indication of Agender Design. In the second semi-structured interview (after Wynn's agender design and They/Them pronouns were made explicit), perceptions of Wynn dramatically shifted, with all but one participant readily accepting Wynn's agender presentation. This shift in perceptions seems to be largely due to Wynn's choice of pronouns:

> *P36* — "I see no reason not to use an agender [design]; to use They/Them pronouns for Wynn and assign them no gender."

4.1.3 Perspectives on Wynn's Pronouns. Another key trend seen in participants' utterances was the uniformly positive response to Wynn's use of They/Them pronouns in the second enactment. Participants explicitly noted the perceived inclusivity and potential for long-term impact for this choice of pronouns:

> *P9* — "I believe that using They/Them was a good call, because it is in of itself inherently genderless, and having something that it does have ... They/Them pronouns to me, as a trans person, that does feel inclusive."

> *P2* — "If you had a robot that was designed with a gender in mind, then I think [the use of] pronouns ... would [help] towards that goal of normalizing [pronoun use]."

> *P8* — "I thought that they actually made the consideration that people would be affected by [Wynn]. Of course, my natural inclination is, 'Oh God, people are gonna freak out' [about pronoun use], but you know, whatever, this is the world we live in and it's nice to know those sorts of things."

While participants had positive perceptions of Wynn's use of They/Them pronouns, they were more split on the alternatives like It/Its. Some participants argued that It/Its would be as or even more appropriate than They/Them pronouns:

> *P10* — " 'It' is a perfectly valid gender, and that is the one I assigned it. It's a thing, not a person."

Others were wary of the way that It/Its pronouns might serve as implicit critiques of non-binary gender identities:

> *P8* — "I don't wanna call them an 'it' because that's sort of diminishing in my opinion, Robot or not."

4.2 Perspectives on Gender in Robot Design

Three key subthemes emerged surrounding participants larger perceptions on gender in robot design: (1) benefits of agender robot design, (2) benefits of binary gendered robots, and (3) alternatives beyond agender and cis-binary robot designs.

4.2.1 Benefits of Agender Design. Most participants were supportive of explicitly agender robot design. A key reason for this support was due to the perceived subversion of heteronormativity. Specifically, a number of participants viewed agender robot design as an important way to avoid reinforcing the gender binary:

> *P9* — "Well I believe all [binary design] would mainly do is just reinforce gender roles..."

4.2.2 Benefits of Cis-Binary Design. On the other hand, other participants noted potential benefits of leveraging traditional notions of gender, and even expressed concerns surrounding the use of genders that some could be unfamiliar or "uncomfortable" with in healthcare settings like hospitals, long term care facilities, and home care. As one example:

> *P1* — "I have to get pap smears... And what I find really interesting is that dealing in a human setting, more often than not, I actually prefer to have a male gynecologist."

4.2.3 Alternatives Beyond Agender and Cis-Binary Robot Design. Finally, participants identified a number of alternatives beyond solely agender or cis-binary robot design.

Some participants expressed a desire to choose a robot's gender themselves, rather than have this decided for them by robot designers. One participant used an analogy to their current ability to customize the voice of their home assistant devices:

> *P1* — "Google Home is set up to have a female voice because for me, I respond better to that. That works for me and that makes the tool essentially work for me."

While this sentiment aligns with current HRI research trends surrounding personalization and customizability, it is well known that merely adhering to robot designs perceived as most likable and comfortable can reinforce gender biases and stereotypes[24, 42, 46, 49]. In the case of transgender and non-binary robot design, it may be particularly important to be wary of these risks, especially given the types of robots for which companies are currently offering such "customizations" – sex robots [19].

Finally, some participants saw humanlike notions of gender as something to be avoided altogether:

> *P9* — "Personally, I don't think unless it's absolutely needed, we should be gendering things."

4.3 Opportunities for Long-Term Exposure

Three key subthemes emerged surrounding participants' hopes for the long-term societal impacts of agender robot design: (1) normalization of non-cis gender identities for (unrealized) non-cis individuals, (2) normalization of non-cis gender identities for (realized) non-cis individuals, (3) normalization of non-cis gender identities for cis individuals.

4.3.1 Normalization of Non-Cisgender Identities for (Unrealized) Non-Cis Individuals. Some participants spoke about the effects that exposure to non-cis individuals had on them before they questioned their own gender identities, and speculated that robots could provide similar stimulation-to-question for others:

> *P1* — I only found out about trans people and the trans community because ... Caitlyn Jenner was in the news... And I went to learn about trans people and find information because I wanted to be the best person who could argue... why trans people shouldn't exist. However, through research I got exposure to all these different pieces of information. And then there was a really kind of defining moment where I met a trans person... If people don't know that something exists and if people just think it's like something that's 'over there', then they can ignore it."

This account served as a powerful example of the ways that exposure can support self-realization. This possible influence of robots was noted by multiple participants.

4.3.2 Normalization of Non-Cisgender Identities for (Realized) Non-Cis Individuals. Other participants noted the potential benefits that non-cis robots could have to the transgender and non-binary communities, in terms of self-perceived representation.

> *P6* — "I think it's actually very important. I think that given the social cache where there's not a lot of queer identities amongst the celebrity class or political class even, and especially with the trans topics that are going around policy wise, I think that having more ... representation ... is helpful."

Even participants who didn't think that agender robots would have large-scale societal impact expressed potential value of agender robots for themselves:

> *P9* — "[For] people who already do have a mindset about gender that's outside the binary, I think that's just going to help reinforce their worldview a little bit... If I saw a robot like [Wynn] and if I asked it, 'Hey what are your pronouns?' And it said 'They/Them', I'll go. 'Oh cool! Good.'"

4.3.3 Normalization of Non-Cisgender Identities for Cis Individuals. Finally, a number of participants noted the potential impacts that exposure to non-cis robots could have to society at large. Participants readily speculated about the impact that exposure to trans and non-binary ideas could have on society:

> *P1* — "I think [agender robot deployment] would have impacts, right? ... So if something is queer coded, people can respond positively or negatively to it. I think that you would have the same thing if it was a robot or a person."

Moreover, while not all participants felt that agender robots would necessarily have tremendous impact, the perceived impacts people did expect to come out of exposure to trans and non-binary ideas through robots was largely positive:

> *P10* — "Exposing people to these concepts is simply how they become normalized and less othered, which is for sure something I would like to see."

Some participants even agreed that repeat exposure to different gender concepts through robotics could change how the general public thinks about gender.

> *P4* — "[Exposure] could sort of help people become more familiarized, maybe sort of open up this area between the binary and maybe people think well, well you know, maybe there is a space in there."

> *P8* — "...exposure to that sort of concept and realizing that [non-cis people are] just as functional and the same and as personable and real as anyone else, it eventually hopefully will negate the whole concept that this is a different thing, this is a divergent thing and creates normalcy..."

Participants also noted benefits of agender robots for normalizing non-cis practices such as singular They/Them pronoun use, which is still sometimes viewed as novel despite its long history of use in the English language [3]. Pronoun use was perceived as providing space for non-cis people to be open about themselves:

> *P2* — "[Pronoun use is] an open invitation for that person to share their pronouns, you know?... If cisgender people are using their pronouns then it's not like it, it's not like automatically outing yourself by saying what your pronouns are. Cause if everyone's doing it, [it is] normalized"

This represents a key opportunity for the HRI community, as there are several ways that practices like They/Them pronouns could be normalized through robotics, from robots using these pronouns themselves, to robots understanding and generation them, to the use of robots to call out pronoun-based norm violations, microaggressions, and anti-LGBT sentiments (see recent calls for and discussions of such capabilities [4, 23–25, 47, 49], but also [45]).

To summarize, as one participant argued:

> *P5* — "I'm completely fine with robots being non-binary or specifically trans. And I think it might actually do good for non-binary and trans people by helping [the public] to get more used to the idea of transgender people and non-binary people. I've been seeing just a lot of hate against transgender people and non-binary [people] recently. [But interaction] with transgender robots ... might help."

4.4 Risks voiced by Non-binary and Trans Individuals

Despite these potential benefits, participants also saw several key risks surrounding agender robot design. Three key subthemes emerged surrounding these risks: (1) fears of backlash, (2) fears of caricature, and (3) fears of dehumanization.

4.4.1 Risks of Backlash. Many participants expressed concern regarding public backlash to agender robots. As one participant imagined the public response:

> *P1* — "Who needs these woke robots anyway?"

While such responses are not in and of themselves a reason to avoid a socially responsible design choice, some participants raised acute – and chilling – concern about the risks of public exposure.

> *P3* — "There was definitely a time within the last 10 years when visibility for [transgender people] taught people ... about us. I'm pretty sure that time has passed. The visibility that came started when ... Jenner came out, right? ... [But now], I think the more people think about us, the more of us they're gonna kill."

This sentiment speaks to the real risks faced by trans individuals in today's society, especially in countries like the US, where the number of transgender murders has doubled since 2018 [31].

4.4.2 Risk of Caricature. In addition, some participants raised concerns about the performative nature of non-cis robot design, and the risks of caricaturing non-cis people. A number of participants, for example, pointed to the nature of transgenderism as a fundamentally *human* experience:

> *P2* — "Transgender is [a life experience where] something was not right to begin with. So having to make a specific change, it comes with the package of certain social difficulties, social change, [and] lived experiences that cannot be shared by a robot. And ... I don't think you can design [that] into a robot. And really transgender is sort of, you know, born in the wrong body sort of experience. I don't think that works with robots."

While these critiques may be applied to any dimension of robot design given robots' potential status as depictions [9], participants noted how this particular authenticity gap could pose more concrete risks to trans and non-binary communities. Multiple participants expressed concerns surrounding the ways that non-cis robots could be used by companies in service of "Rainbow Capitalism", to put on a falsely inclusive face without meaningfully fighting oppression.

> *P7* — "I would take issue with it if there was something kind of like, you know, corporate pride washing where the Robot comes with like a non-binary flag sticker in the box ... or if there's like real marketing emphasis placed on the

non-binary[-ness] of this Robot as like a real selling point, versus just like a fact about this Robot."

Another participant put it more bluntly:

P3 — "Is Wynn going to be a silicon Br'er Rabbit?" [Referring to the misuse of African oral tradition to glorify slavery [29]] ... "If Wynn just ends up [as] a caricature of non-binary people, well that could be damaging."

Meanwhile, others felt that this risk was not inherent to agender design, but dependent on the motivations and execution of the robot's deployers.

P6 — "It depends on how [agender robot deployment is] done, and whether it's done just as social marketing, or whether it's something genuine."

4.4.3 Risk of Dehumanization. Finally, several participants raised concerns that agender design of robots could lead to the public associating non-cis people with robots, and thus dehumanizing non-cis people as a result.

P4 — "[I] worry about the agender nature of a robot [that is] clearly not human... [being] used as a tool or even just a bullet point in dehumanizing *people* who are agender"

More specifically, participants raised the concerns of dehumanization *in the case where all robots are designed as agender*:

P2 — "If all human-facing robots are ... non-binary or agender ... and use They/Them pronouns ... that could lead to people associating humans who identify that way [with robots]."

Or, as another participant put it,

P4 — "[non-binary robotic representation] could mean 'well here's where the robots go, and here's where all of the non-binary people go: in there with the robots.' "

Meanwhile, other participants emphasized that these concerns over dehumanization might be too focused on a remote possible future, and a need to instead focus on the benefits these robots could have in the here-and-now.

P3 — "Until these things become as commonplace as smartphones... I don't really see that being a problem."

4.5 Political and Economic Concerns

Finally, two key subthemes emerged surrounding the political and economic factors that shape the benefits and risks described above.

4.5.1 Political Climate. Many participants speculated as to how responses to agender robots might be shaped by localized cultural and political factors. Transgender participants who had lived in conservative areas expected their neighbors to be unreceptive or even violent toward non-heteronormative design, but saw potential for implementing robots that express agender or other-genderedness in more socially liberal areas of the United States.

In regard to their own local experience, one participant said:

P8 — "I live in a [socially conservative] town, I couldn't see them hiring a robot that was referred to as They/Them."

Other participants considered the importance of these regional differences for robot safety (a real concern given the harm abuse toward robots can cause for marginalized populations [18]):

P10 — "I'd say it's really contextual depending on their role, and especially like transgender presenting robots, I would assume, depending on [where] they might be deployed, [they] would be more likely to be destroyed or harassed or interfered with because of that presentation."

4.5.2 Economic Climate. Finally, while unexpected at the onset of our interviews, many participants expressed larger concerns about robotics, regardless of how they are gendered, given the economic systems into which they are being integrated.

P10 — "I wish robotics were gonna be used to make everyone's lives better, but they're just gonna be used to cut people from low level work, and that scares me."

Indeed, for many participants, economic concerns surrounding robotics and automation outweighed those surrounding gender representation. When asked about how Wynn might change conceptions of gender, one participant skipped right to labor concerns.

P3 — "I think the biggest effect that automation of this sort is going to have is in unemployment."

While not all participants shared these concerns, they are still worth emphasizing here due to the outsized proportion of LGBT people in low-wage jobs. LGBT people in general are subject to much higher levels of unemployment than non-LGBT individuals, and transgender people are subject to yet higher rates [30].

5 DISCUSSION

The breadth of insights acquired across this work underscore the arguments made by scholars like Winkle, Perugia, Korpan, Seaborn and Spiel regarding the serious problems surrounding the homogeneity of both researchers and participants in the HRI and HCI community. Our trans and non-binary participants had clear, actionable, and well-informed perspectives to share on the types of design strategies roboticists should be following, the types of risks they should be attentive to, and the factors they should be considering when deciding whether or not to use robots at all.

Critically, many of these clear-eyed perspectives offered by our participants approached key debates within the HRI community from angles completely orthogonal to the spectrum of possibilities that are typically considered. Our participants presented fundamentally *new* possibilities and logics for approaching and making sense of the role of gender in robot design. Moreover, participants' approaches to the ethical questions that should guide robot design hewed much closer to the types of Feminist scholarship only recently advanced in the field by Winkle [48]: participants' hopes and concerns went far beyond the effects by, and on, the human and robot involved in an interaction, considering instead a wide range of stakeholders, including the motivations of big tech companies and the effects on observers. Similarly, participants' concerns focused more on roboticists' ability to wield cultural power than on robots' ability to engage in persuasion – a type of ethical consideration more in line with Collins' Matrix of Domination [10, 11] than with traditional conceptualizations of power and influence used in HRI.

Overall, then, our results suggest that it is high time the field of HRI listen to – and elevate – the perspectives of trans, non-binary, and other queer people. With that understanding, let us now briefly

summarize exactly what actions we recommend the field of HRI take, if we actively include those perspectives.

5.1 Recommendations for the Field of HRI

Based on the insights provided by our participants, we propose three key recommendations for the field of Human-Robot Interaction.

Recommendation 1: HRI researchers should embrace agender design as an alternative to the cis-binary status quo.

While our participants did not ascribe to a single perspective, there was general agreement that agender robots are a promising approach to avoiding unnecessary ascriptions of masculinity and feminity while also increasing public exposure to non-cis identities. This is not to say that robots are the solution to non-cis invisibility, as opposed to increased inclusion of non-cis humans and centering of non-cis perspectives, but rather that if humanlike social robots are to be deployed, increased exposure to non-cis identities would be one positive outcome of agender design.

Recommendation 2: HRI researchers should explore a broader array of both cisgender and non-cisgender robot designs through careful focus on the characters our robots depict and how they are perceived.

Our results also show that agender design is not a panacea, and that for it to be effective while avoiding risks of dehumanization, it should be used alongside other robot designs. More generally, then, our field needs to embrace the perspective advocated by Clark and Fischer [9]: whether intended or not, our robots present *depictions* of characters, and we should give more careful thought to how those depicted characters will be perceived in the potentially politicized contexts in which they will be deployed.

Recommendation 3: HRI researchers should continue to look to trans, non-binary, and other queer populations as participants, as designers, and as researchers, especially on topics relating to gender in robot design.

While careful attention to the characters our robots depict may help avoid risks of nonauthenticity and rainbow capitalism, these risks may also be headed off more directly by hiring and recruiting trans and non-binary people at all stages of the design process: as end users (especially when following Costanza-Chock [12]'s philosophy of Design Justice), as participants, as co-designers, as researchers, and as leaders (cf. [2, 32]).

In this work we aimed to elevate the voices of trans and non-binary participants, but moreover, the primary researcher engaged in all design choices was non-binary, and both authors made sure to check in and discuss their methodology with other trans and non-binary researchers during the research process. While an inclusive design approach is important for all HRI research, it is especially important to ensure that agender or other non-cis designs approaches are approached from a place of genuine care. Even well-intentioned, empathy-based, and theoretically well-grounded approaches cannot supplant inclusive design.

5.2 Limitations and Directions for Future Work

While this work is an important first step for our field, its boundaries represent key opportunities for future work.

First, while this work was grounded in semi-structured interviews, quantitative studies are needed in future work to back-up our qualitative insights. Moreover, other types of qualitative methods, such as design workshops, could add further nuance and complexity to the base layer of findings presented here.

Second, though our online methodology was critical for recruiting participants, our use of videos necessarily prevented participants from directly interacting with the robot, and questions not related to those videos may have prompted ungrounded speculation. Future work should explore the use of in-person interviews, or online interviews that include live robot demonstrations.

Third, while this work is notable in its explicit consideration of trans and non-binary individuals' views on robot design, it is limited in that our sample was mostly comprised of White trans-women. Future research should seek to recruit individuals with a wider array of trans, non-binary, and gender non-conforming identities, from a broader set of intersectionally diverse backgrounds. Just as cis men and women have differing experiences, trans women and men have differing experiences. Transgender women, for example, may be more likely to face the specific types of discrimination and bias faced by cis-women. Non-binary individuals' experiences differ based on how they present (e.g., open vs closed); and even those who do not openly subvert gender norms may face unique forms of stress from hiding themselves. Additionally we recommend proactively forming active and ongoing relationships with LGBTQ+ organizations and people in order to aid in recruitment, due to the sensitive nature of the questions under investigation.

Fourth, while this work is notable in its consideration of robots depicting agender characters as distinct from "genderless" robots, this is just one starting point from which a host of design patterns could be examined, including queer, genderfluid, and other non-cis, non-binary, and non-heteronormative robot designs. Future research should also explore a wider array of issues beyond trans and non-binary perspectives on robot character design, such as transgender perspectives on robots used in medical care.

To guide these future research efforts, researchers may be best served by following recent guidelines from scholars like Winkle et al. [47], Seaborn and Frank [38], Spiel et al. [41], and Burtscher and Spiel [6], who provide helpful guidelines for pursuing critical, sensitive, responsible research on gender in HRI and HCI.

6 CONCLUSION

Our results show the importance of being explicitly inclusive of transgender and non-binary perspectives in robot design: trans and non-binary participants hold unique and nuanced views critical for the design of robots and for understanding the sociopolitical ramifications of those choices. HRI cannot rely on traditional practices based only on a cis-binary understanding of gender. Even in this first study, our results suggest actionable new paths forward ,through agender, rather than "genderless", design. More work is needed to build on these new insights as we move towards a more inclusive – and subversive– HRI.

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A   INTERVIEW QUESTIONS, PART I

(1) What were your initial impressions of the robot? (RQ1)

(2) If you were to interact with Wynn, how would you address Wynn? (RQ1)

(3) Would you assign a gender to this robot, and if so, what would it be? (RQ1)

(4) Why did you make the choice that you did? (RQ1)

(5) Was your choice due to the voice, the body, or some other factor? (RQ4)

B   INTERVIEW QUESTIONS, PART II

(1) How did the use of pronouns and the mention of explicit agender design choices affect your view of Wynn, if at all? (RQ2)

(2) Most robots are assigned "he/him" or "she/her" pronouns. Should we have assigned "they/them" pronouns to a robotic platform in the first place, and why or why not? (RQ2)

(3) Some people have expressed concerns surrounding appropriation of identity for this type of design. Do you see any risks along these lines if a robot like Wynn uses They/Them pronouns, or with any other aspects of intentionally non-binary design? (RQ3)

(4) Many current robot designs are explicitly cis-male and cis-female robots. Given that, what do you think overall about the idea of designing robots that are explicitly non-binary and/or transgender? (RQ3)

(5) People are proposing the use of robots like Wynn in roles that involve human interaction, including roles in healthcare and service. Are there any social benefits and/or risks to trans and non-binary people due to robots like Wynn being created and deployed in human-facing roles? (RQ3)

(6) Robots can also fill roles that are less human focused, such as warehouse robots, maintenance robots, and cooking robots. Do you see different risks and benefits for transgender and nonbinary people if robots like Wynn are deployed in any other use cases? (RQ4)

(7) Should we design gender into robots just because people anthropomorphize?

(8) Do you see any risks or benefits for trans and non-binary people if roboticists implement explicit male and female designs instead of agender designs? (RQ3)

(9) How do you think a Robot like Wynn could affect how people generally think about gender, if at all? (RQ3)

(10) What are choices that roboticists could take with robot design to reduce risks and harm to non-cis individuals? (RQ4)

(11) How do you feel about a robot like Wynn being used in a service role, similar to the exercise? (RQ4)

(12) We tried to avoid an overly human-looking robot for this exercise. Would you have preferred that a different platform was used for agender design? (RQ4) If so, what would the design choices of that platform look like and why? If not, why is that?

(13) Given that many robotic designs do present intentionally as male or female, how do you feel about the general concept of binary robot gender design? (RQ1)

(14) Given that most roboticists are Cis-gender, and a majority of them are male, how do you feel about roboticists engaging in explicit gender design in any capacity? (RQ1)

(15) Considering that robots range from deliberately human-looking to entirely mechanical, do you feel that avoiding binary gender association is possible? (RQ4) If so, what sort of robot would avoid this problem? If not, why do you think we cannot avoid it? If you are uncertain, why is that?

(16) Can you think of any appropriate use cases at all for robots with a binary based gender design? (RQ4)

(17) Can you think of any use cases where agender design might be better or worse than binary-based design? (RQ4)

(18) What are other ways we could deal with gender in robotics? Should we be designing robots to have a gender at all? (RQ1)

(19) Are there any further considerations concerning gender in robotics that we should talk about that we have not discussed so far? (RQ1)