



# Do Robots Have Sex? A Prolegomenon

Robert Sparrow<sup>1</sup> · Eliana Horn<sup>1</sup> · Friederike Eyszel<sup>2</sup>

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## Abstract

Research in Human–Robot Interaction (HRI) suggests that people attribute gender to (some) robots. In this paper we outline a program of research on the gendering of robots and on the ethical issues raised by such gendering. Understanding which robots are gendered, when, and why, will require careful research in HRI, drawing on anthropology and social psychology, informed by state-of-the-art research in gender studies and critical theory. Design features of robots that might influence the attribution of gender include: appearance; tone of voice; speech repertoire; range and style of movement; behaviour; and, intended function. Robots may be gendered differently depending on: the age, class, sex, ethnicity, and sexuality of the person doing the attributing; local cultural histories; social cues from the designers, the physical and institutional environment, and other users; and the role of the robot. An adequate account of the gender of robots will also need to pay attention to the limits of a sex/gender distinction, which has historically been maintained by reference to a “sex” located in a biological body, when it comes to theorising the gender of robots. We argue that, on some accounts of what it is to be sexed, robots might “have” sex: they might be male and female in just the same way as (most) human beings are. Addressing the ethical issues raised by the gendering of robots will require further progress in “robot media ethics”, as well as an account of the responsibilities of both designers and users in a broader social context.

**Keywords** Robots · Gender · Ethics · Sex · Human–robot interaction · Social robotics

Research in Human–Robot Interaction (HRI) suggests that, amongst other traits, people attribute gender to (some) robots. That is, they relate to robots in ways that are shaped by sex/gender schemas that structure human interactions with other human beings. There has been a recent flurry of interest in the ethical problems posed by this gendering. However, the nature, limits, and significance of the gendering of robots remains underexplored, as do the ethical issues that it generates.

In this paper we outline a program of research on the gendering of robots and the ethical issues raised by such gendering.<sup>1</sup> Understanding which robots are gendered, when,

<sup>1</sup> As we discuss below, a key consideration in this program relates to the definition of sex and gender and (thus) the relationship between them. As we also discuss below, these matters are highly controversial and vigorously contested. A full account of how we intend these terms—and our reasons for not attempting to settle these matters in this paper—is provided in the section “Sex/gender: A tendentious dichotomy” (see below). However, for the sake of ease of exposition, we shall briefly prefigure this discussion here. For the most part, in what follows, we use “sex” to refer to the property of being male or female (or another sex, such as intersex or non-binary) and/or an individual’s (or entity’s) place in relation to these categories. We use “gender” to refer to the question as to whether someone or something is masculine or feminine (or some other, third, term) rather than male or female, although there are places where (we hope) context makes it clear that we use “gender” in its ordinary sense, in which it includes sex, in order to leave the question of whether it is social role or anatomy that is at issue open. Often, we write “sex/gender” to foreground that we are concerned with both. We use “gendering” to refer to the phenomenon, and the processes, whereby robots come to be seen as masculine or feminine *and/or* male or female: where we use gender as a verb, it has the same meaning. A key concern throughout is to under-commit to the question of the precise relationship between sex and gender both in order to avoid being implicated in the controversy about this matter and in order that those

✉ Robert Sparrow  
robert.sparrow@monash.edu

<sup>1</sup> Philosophy Program, Faculty of Arts, Monash University, Melbourne, Australia

<sup>2</sup> Center for Cognitive Interaction Technology (CITEC), Bielefeld University, Bielefeld, Germany

and why, will require careful research in HRI, drawing on anthropology and social psychology, informed by state-of-the-art research in gender studies and critical theory. Design features of robots that might plausibly influence the attribution of sex/gender include: appearance; tone of voice; speech repertoire; range and style of movement; behaviour; and, intended function. Robots may be gendered differently depending on: the age, class, sex, ethnicity, and sexuality of the person doing the attributing; local cultural histories; social cues from the designers, the physical and institutional environment, and other users; and the role of the robot. Disentangling these—and other factors—will require careful research using multiple methodologies, including: cultural studies; discourse analysis; laboratory ethnographies; interviews with, and surveys of, users; studies of user behaviour; science and technology studies; history; and sociology. An adequate account of the sex/gender of robots will also need to pay attention to the limits of a sex/gender distinction, which has historically been maintained by reference to a “sex” located in a biological body, when it comes to theorising the gender of robots. A distinctive contribution of our discussion is that we argue that, *on some accounts of what it is to be sexed*, robots might “have” sex: they might be male and female in just the same way as (most) human beings are. Insofar as it is concerned with questions of gender in a context where there is no “truth of the body”, HRI research on the gendering of robots has the potential to contribute to, and not just benefit from, research in gender studies. Addressing the ethical issues raised by the gendering of robots will require further progress in “robot media ethics”, as well as an account of the responsibilities of both designers and users in a broader social context: it will also require us to confront difficult questions about the nature and role of sex/gender in the world as we find it and the world to which we aspire.

## 1 The Scope of the Investigation

Questions relating to the gendering of robots are a subset of questions about gender and robots. There are important questions about gender and robots, including questions regarding barriers to the participation of women in robotics research, about the differential impacts of labour market disruption due to robots on men and women, and about the gender politics of different purposes for which robots are being developed, which are relatively independent of whether robots are held to be male or female or masculine or feminine.<sup>2</sup> Our concern here is with the latter matter: that is, with the question of

Footnote 1 continued  
on both sides of this controversy might be able to find something of benefit in our discussion.

<sup>2</sup> This is not to suggest that, for instance, the gendering of robots might not be one of the factors that works to exclude women from participation

whether, and if so how, when, and why, robots “have sex” or “have gender”?

Our treatment of this matter builds on previous research on the topic, including, in particular, key work by Alesich and Rigby [1], Carpenter et al. [2], Cranny-Francis [3], Nomura [4], Robertson [5], and Tannenbaum et al. [6]. The current manuscript goes beyond these in: the depth of the discussion of the relationship between sex and gender, attempting to provide a comprehensive account of the different factors that may contribute to the gendering of robots, considering the possibility that sex is a real property of some robots, treating ethical as well as empirical questions, and, discussing how the ethical and empirical questions interrelate.

## 2 The Tools We Need

Understanding when, how, and which, if any, robots come to have sex/gender will require multidisciplinary and transdisciplinary research, involving (at least) HRI, gender studies, and critical theory.

It will require research in *HRI*, particularly that part of the discipline that draws upon and overlaps with anthropology and social psychology. The phenomenon under investigation—sex/gender—is itself the topic of investigation of a discipline of its own—*gender studies*—and understanding the gendering of robots will require collaboration between HRI researchers and gender studies researchers [7]: each of these disciplines may have much to learn from the other in the course of this collaboration. As we argue below, studying the gendering of robots will also require engaging with difficult questions about the nature of gender and sex and the relationship between these concepts, which have been most discussed in critical theory. For this reason, *critical theory*, and especially feminist critical theory, offers vital resources for this project [8, 9].

Whatever the outcome of an investigation into the gendering of robots, because sex/gender fundamentally structures existing human societies and relations between human beings, the results of this investigation will have large implications for the way human beings relate to robots and the effectiveness of robots in various roles. Consequently, it will raise questions in *ethics* and—especially political—*philosophy* [10].

As well as these disciplinary resources, the subtle and dynamic nature of the phenomena under investigation means that researching the gendering of robots will require a high degree of methodological rigour. In particular, it will require moving beyond research involving vignettes and/or videos of robots to study human robot interaction “in the wild”—that

Footnote 2 continued  
in STEM disciplines. However, it is to insist that the latter problem is larger than—and would not be solved just by addressing—the former.

is when people are actually engaging with real robots and not just with their preconceptions about robots [11, 12]. It will require research involving different cohorts and large sample sizes. It will also require experiments with appropriate control conditions. This latter demand is particularly challenging given that it often can be difficult to identify the relevant variables—and thus controls—when working with robots: should the control condition be another robot with different features or an object or person with the same features that is not a robot? An engagement with intersectional feminism is also crucial in this regard insofar as one of the key findings thereof is that sex/gender is imbricated with race, class, age, and sexuality, such that, for instance, what it is to be a man or woman may be very different depending on whether one is rich or poor or black or white [8, 13–15]. Another key insight from intersectional feminism—indeed from feminism and critical theory more generally—is that the important research questions, as well as the answers to these questions, differ depend upon who is asking them [8, 16, 17]. When it comes to social phenomena, in particular, members of different social groups may have different insights. For this reason, it will be important to strive for diversity within the research community working on the gendering of robots. Given the low levels of diversity within the robotics and engineering communities [18, p. 34], this is a significant challenge. The fact that our societies and cultures are so deeply structured by sex/gender—and that this system brings it about that different people have different material interests in relation to this system—also means that the ethical and philosophical issues related to sex/gender are subtle and complex. We hope researchers will resist the temptation to fall back on shallow cultural generalisations about sex and/or gender or to try to apply ethical theories “out-of-the-box” to solve the ethical dilemmas their work exposes: there is ethical and philosophical work to be done here, as we demonstrate in what follows.

### 3 Sex/Gender: A Tendentious Dichotomy

A significant challenge in investigating the gendering of robots is characterising the phenomenon under investigation. If, as seems likely, people think of some robots as being “men” and others as being “women”, are they attributing sex? Or gender? Is this distinction, between sex and gender, even useful when thinking about robots or, indeed, more generally?

The nature of the distinction, if any, between sex and gender, and the relation between these phenomena, are highly controversial in gender studies and critical theory [19, 20, 21, p. 7, 22, 23]. These matters are also contested by—because they matter for—feminist, queer, and trans activists in the

“culture wars” around gender (sometimes called “sex”) reassignment (or “confirmation”) surgery. Given the depth and complexity of the issues involved we cannot hope to resolve them here. Nevertheless, researchers investigating the gendering of robots need to be aware of these controversies and what is at stake in them: it is also vital that this research community is clear on what, precisely, it is investigating.

Acknowledging, then, that the distinction is controversial, those who *do* operate with the distinction between sex and gender typically distinguish between these two things in the following manner. “Sex” is thought to be a matter of biology, related to an organism’s resemblance to a “type”, which is itself defined by its role in reproduction [6, 24, 25]. A majority of human beings are either male or female, with a small minority being “intersex” or (perhaps) “non-binary” and sharing features of each sex [26–28]. Although determining the sex of a particular individual may be difficult, distinguishing the type “male” from the type “female” is straightforward and is a matter of genetics, anatomy, and physiology. As such, sex does not vary significantly between societies or cultures. For any given individual, there is a “truth of the body” with reference to which the matter of their sex should be determined. By contrast “gender” is understood to be a matter of social role [19, 29, p. 28]. Behaviours—and thus individuals—are “masculine” or “feminine” or perhaps “genderqueer” (or just “queer”). Insofar as gender is related to behaviour and not bodies, gender is significantly more “fluid” than is sex. A person may behave in a more masculine or feminine fashion in different contexts and behaviours that are masculine in one society may be feminine in another. As this latter observation suggests, according to this way of understanding sex and gender, where answering the question of whether a particular individual is male or female requires an investigation of their biology, informed by the relevant science, answering the question as to whether they present as masculine or feminine (or as non-binary) requires observing their behaviour and also knowledge of the relevant cultural norms. Importantly, while sex and gender are interrelated at the level of culture—masculine traits are those associated with men, feminine traits are those associated with women—at the level of the individual, sex and gender may come apart [30, p. 21]. For instance, an individual man might consistently behave in a feminine manner without thereby ceasing to be male.

This way of drawing the distinction between sex and gender—and, indeed, the distinction itself—has been, and continues to be, subject to criticism on at least four grounds. First, the independence of sex and gender may be challenged by pointing out that, although it is true sex and gender may come apart in individual cases, gender encodes generalisations about sex. Conservatives, (some) evolutionary psychologists, and those sympathetic to socio-biology, have sometimes argued that at least some of these generalisations

are accurate and founded in the different roles the sexes play in relation to reproduction and, especially, the care of infants [31, 32, p. 84, 33]. Second, conversely, some researchers have mounted powerful challenges to the empirical claims that are typically used to support the idea that there are only two human sexes, and that sex and gender can be neatly separated [34–36]. Third, relatedly, an influential line of thought follows Judith Butler [19, 37] in rejecting the idea, implicit in the distinction, that sex is somehow more real than gender by virtue of being located in the body [38]. On a day-to-day basis, we judge people to be male or female (or non-binary) on the basis of how they look, talk, and act, without knowing anything about their genitals, chromosomes, or endocrinology. Sex is never determined by “the body” itself but by social practises—which sometimes, but not always, include scientific practises—that are socially contested and that have changed over time [39, p. 7, 40]. Thus, sex is as much a social construction as is gender [41, p. 2, 42–44, p. 24] and should itself be understood as a form of gender [41, 45, p. 230, 46, pp. 90, 131–132, 47, pp. 161–167]. Finally, fourth, some critics object to the implication that there is a single way of being sexed, and thus to the whole project of trying to define sex or gender [48–51].

It might be thought that references to reproduction and to biology in a definition of sex makes it straightforward that robots cannot have sex but only, perhaps, gender [52]. This is too swift. Even if the concept of sex is linked to reproduction, it need not be the case that particular individuals must be able to reproduce to have a sex. It is, for instance, possible to be an infertile man, or woman, or a male, or female, infant.<sup>3</sup> The idea that sex is a matter of biology is, perhaps, more likely to disqualify robots from sex. However, there are at least three reasons to avoid a rush to judgement on this matter. First, the nature of robots as artefacts does not prevent them having other features, such as “eyes” or “hands” that look to be just as “biological” as sex. Second, some—arguably the dominant—social understandings of gender-transition and sex-reassignment/confirmation surgery imply that, while sex is a matter of bodily difference, an individual’s sex is not determined by the body into which they were born or by any of the biological “facts” (anatomy, chromosomes, gonads, endocrinology) that those who advocate biological accounts of sex emphasise. To the extent to which we think of bodies as themselves artefacts and an individual’s sex as something that can change, the idea that entities with non-biological bodies might be sexed becomes more plausible. Third, as we noted above, and will discuss further below, an influential contemporary theorisation of sex insists that sex itself is

socially constructed and should, therefore, be understood as a form of gender [41, 45, p. 230, 46, pp. 90, 131–132, 47, pp. 161–167]. If to be male or female is to be acknowledged by others as male or female, it does not seem impossible that robots will have sex [55].

The definition of sex and gender, and the relationship between them, are some of the most controversial questions in the human sciences and we cannot possibly hope to settle them here. However, we will argue below that, *at least on some plausible account of the nature of sex*, some robots will, indeed, be male or female. Even if readers should ultimately conclude that robots don’t “really” have sex and that all our language here is metaphorical, the question of how people think about, and treat, robots when it comes to both sex *and* gender will remain of interest.

### 3.1 Language Matters

The fact that there are different phenomena that might be investigated when it comes to the gendering of robots and the slippery and tendentious nature of the sex/gender distinction has a number of implications for best-practise research in the area.

First, researchers need to be very clear what they mean when they use the words sex and gender and should, ideally, specify how they understand the relation between these two terms. Experiments should be designed with the distinction between sex and gender in mind, or, at least, in the light of the way researchers *and their research subjects* understand the relation between these terms [56, 57]. In particular, researchers need to be aware of the possibility that when they ask questions about gender their respondents may answer in terms of sex and vice versa. Clarity and precision in this regard are rendered difficult by the fact that English language users often use “gender” to refer to sex differences and that, in the context of the investigation of robots, none of the easily available sets of contrasting terms in English (man/woman, male/female; masculine/feminine) reliably picks out sex rather than gender or gender rather than sex. Similar confusions risk arising in research and discussions conducted in other languages. Decisions about research design and the choice of language to use therein, and elsewhere, are rendered even more complex by the fact that it will often be appropriate to introduce a third term to the categorization of sex *and* gender, both to allow for the possibility that some robots may resist classification as either male or female or masculine or feminine and because some audiences (and some research participants) may demand this and be offended these options are not made available. The decision to use such third terms—or not—is highly loaded theoretically, insofar as it then becomes necessary to clarify whether they are intended to allow for the possibility of individuals (or, in this case, robots) to whom classification

<sup>3</sup> Moreover, in fact, as an anonymous referee encouraged us to note, there exists a subfield of robotics research—“Evolutionary Robotics”—wherein the idea that robots might reproduce is a core theoretical assumption [53, 54].

according to sex or gender do not apply or whether they are supposed to refer to a sex that is neither male nor female or a gender that is neither masculine or feminine [27, 58–61]. The inclusion of such terms in the design of research is also highly likely to frame participant responses and thus significantly influence the results of research. Where such third terms are included, it will be important to consider whether it is possible—and how, if it is—to distinguish instances in which research subjects consciously wish to assign them to robots from those in which they simply think that neither of the other terms apply.

Second, it is important to recognise that different authors may use these terms differently and thus be alert to the possibility that other authors may use the word sex where one would use gender and vice versa. It is also wise to be alert to historical, disciplinary, and national variations in usage in this regard [52]. When studying the research design and interpreting the results of others, it is worth asking consciously how they understand the relationship between these terms.

Third, and finally, researchers need to be aware that the meaning and relation between these terms is highly contested between different social groups as well as between different disciplinary and theoretical perspectives. Insofar as most societies today are highly structured by both sex and gender, the way we understand and use these terms matters. In particular, (many) people care whether they are judged to be male or female (or “trans” or intersex or “non-binary”) and what these terms mean [62, 63, p. 104], they also care who else qualifies for these appellations [64]. Moreover, different accounts of the meaning and relationship between sex and gender are incompatible and have different implications for different people. For instance, if sex is held to be a matter of identification, or felt sense, rather than physiology, then social practises that rely on the possibility of excluding one sex or the other from a particular context may be harder to sustain [65, 66]: the case for state subsidised sex-reassignment/confirmation surgery may also be undercut if one can be entirely male in an anatomically “female” body or vice versa [67]. Conversely, insisting that sex is a matter of “anatomy” or “biology” risks significant harms to those who identify as non-binary or whose felt sex does not match their morphological sex [68, 69]. It is effectively impossible to be neutral in relation to these disputes, so the best researchers can do to avoid causing offence and risking contributing to social harms—and to buttress themselves against inevitable criticism—is ensure that they are aware of these complexities and have thought seriously about them. Best-practice research on this topic will be informed by robust engagement with feminist (e.g., [14, 23, 39, 70–74]), queer (e.g., [19, 75–78]), trans (e.g., [44, 79–82]) and, perhaps, gender-critical perspectives (e.g., [65, 83, 84]).

These questions about language arise, of course, for this paper. Indeed, they are especially acute given that our goal

here is to describe a program of research for investigating the gendering of robots, and its challenges, without prejudicing the result of that investigation. Given the latter concern, we have chosen to use “gendering” to refer to the phenomenon, and the processes, whereby robots come to be seen as masculine or feminine *and/or* male or female: where we use gender as a verb, it has the same meaning. We have chosen to use “sex” to refer to the question of whether robots are—or are held to be—male or female (or another sex), withholding any commitment for the majority of the discussion as to whether sex itself inheres in social relationships, and thus should ultimately be understood as a form of gender, or in bodies. For the most part, we have tried to reserve “gender” for the question as to whether someone or something is masculine or feminine (or some other third term) rather than male or female, although there are places where (we hope) context makes it clear that we use “gender” in its ordinary sense, in which it includes sex, deliberately in order to leave the question of whether it is social role or body that is at issue open. At times we write “sex/gender” to foreground that we are concerned with both. Our goal throughout is to try to show how, at least on some theorizations of the relationship between these things, *both* sex and gender might be at stake in the gendering of robots, without reducing the usefulness of our discussion for those who would deny this.

## 4 Them

Previous work on the gendering of robots (see for example, [6, 52, pp. 99–115, 85, p. 76, 86]), as well as theoretical considerations from gender studies, suggests that the attribution of sex or gender to robots is determined by features of the robots (“them”) and characteristics of the people doing the attributing as well as their social environment (“us”). While this distinction is somewhat artificial—in reality, both sex and gender emerge as a result of the interactions of these two sets of variables—it is a useful way to structure our discussion of the factors that may influence the gendering of robots. In this section, we treat the factors that are more obviously associated with the robot itself and thus within the power of designers to alter. In the next section, we treat the factors that relate to the users and the social context in which robots are used.

### 4.1 Appearance

The physical appearance of robots is the most obvious factor that influences whether, and how, they are gendered [86–88]. Human beings have an evolved psychology and a visual system that is highly sensitive to subtle visual cues that are used to attribute sex. These are especially likely to be activated in relation to robots that have “faces” and/or that are humanoid



in appearance. Thus, for instance, changing the shape of a robot's "jaw" [89], the colour tone of its "skin" [90] or the spacing between its eyebrows, or between its eyes and its chin, may cause people to gender it differently [91]. The addition of facial "hair" to a robot is likely to gender it male. The height and body mass of a robot, and the ratio of the width of its shoulders to hips, may also be interpreted by users as revealing information about sex [85, 92]. Adding breasts to a robot, as the designers of Hanson Robotics' robot "Sophia" did, will usually gender it female. Adding chest hair will gender it male. Adding genitals, as will presumably occur if sex robots eventually become available, will make it more likely that the robot is identified as being male or female, depending on the genitals, at least in those settings in which people are aware of the robots' genitals. The impact that such features have on the sex/gender of a robot may interact with those features of the robot that influence whether the robot is judged to be "young" or "old" and with those that shape the attribution of race [93, 94, p. 7].

Another set of features of the appearance of robots may influence the attribution of sex depending on cultural context. Thus, for instance, the length and style of any "hair" on the head of a robot [86], the nature and style of its "clothes" (if any) [88, 95], the presence or absence of "make up", and the length of a robot's "eyelashes" may shape the attribution of sex/gender [94, p. 4] but may do so differently in different social contexts. The colour of a robot—for instance, whether it is pink or blue—may also lead people to gender it in a particular way [95, 96].

#### 4.2 Tone of Voice

The human ear and brain are highly attuned to differences in pitch and timbre that provide information about the sex of the speaker [97, p. 23]. In cases where robots communicate with users via sound, the pitch and timbre of these sounds are highly likely to play a key role in shaping the attribution of sex/gender to the robot [98–101].

#### 4.3 Speech Repertoire

Some languages mark the sex of the speaker. In many cultures, there are ways of talking or particular subject areas or forms of expression that are associated with gender stereotypes [102–105]. For this reason, both subtle and not so subtle features of the way robots speak and the things they say may influence the attribution of sex and/or gender to robots.

#### 4.4 Range and Style of Movement

In many cultures, not only are boys and girls taught to speak differently they are also taught to move differently. Boys and girls are taught to use different gestures, to deport themselves

differently, and to move through space—and, especially, to negotiate their relationship with the location of other people in space—differently [106, p. 227, 107, 108]. The existence of such sex stereotypes means that the way robots move may communicate information about their sex and/or gender.

#### 4.5 Behaviour

Relatedly, most cultures also sustain gender stereotypes about social "behaviour" construed more broadly. For instance, in some cultures, when welcoming a guest into a home, men may be expected to offer alcoholic drinks, while women are expected to offer food. This means that both what robots do, and how they do it, may prompt people to draw conclusions about their sex and/or gender [109, 110].

#### 4.6 Intended Function

Finally—and also relatedly—despite the best efforts of feminists to destabilise or eliminate these, most cultures still maintain gendered stereotypes about employment and other social roles [111–113]. Some jobs are masculine and (held to be) unsuitable for women, others are feminine and (held to be) unsuitable for men. Where the design of a robot conveys information about its intended function, this may lead to it being gendered [110]. Thus, for instance, it is plausible to think that, in many societies, construction robots will be held to be more masculine, and will be more often held to be male, than nursing robots [87]. There is, obviously, some overlap here with the question of the robot's appearance, discussed above. However, insofar as there is the possibility of a disjunction between a robot's cosmetic features and its intended function as revealed in its design, it is worth distinguishing these factors and their impacts on the attribution of gender and (perhaps) sex.

#### 4.7 Where Does Robot Sex/Gender End?

A key question is this context concerns the limits of the attribution of sex and/or gender when it comes to differences in each of these regards [52]. Is it the case that some robots have sex/gender, but others don't? If so, which, and why? For instance, while it seems likely that humanoid robots will be located in relation to gender-schemas (see below), it is less clear that robots that don't look remotely human, such as autonomous quadcopters or forklifts, will be. The ethical issues associated with the gendering of robots will look quite different if it turns out that it is not possible to design and manufacture robots that are not gendered.

A significant complexity here is that not being "marked" by sex or gender is not the same thing as not "having" a sex and/or gender. As has been documented extensively by feminist critics, in a patriarchal culture, to have a "normal" body

is to be male: to be female is to have a body that deviates from this male norm in various ways [114–116]. Similarly, “feminine” behaviours are those that stand out from a masculine norm. The fact that both sex and gender difference operate on the model of norm/deviation means that a failure to explicitly attribute sex or gender to particular robots, or classes of robots, is compatible with them nevertheless being male and masculine. This does not rule out the possibility that some robots may have neither sex nor gender. However, it does demonstrate that researchers will need to take care to distinguish between the case where robots are gendered male and masculine despite not being explicitly marked as such and the case where these categories simply do not apply.

## 5 Us

Insofar as gender is something that we attribute to robots, or at least that they have by virtue of their relations with us, the gender of robots will also be shaped by human beings and all the different ways in which our thinking and behaviour around sex and gender is shaped by context. People make use of “gender schemas” and “gender stereotypes” to understand the identities and behaviours of those around them [117, 118]. These schemas and stereotypes differ across history, culture, and different social groups, and may be activated differently in different contexts.

### 5.1 The Users

The attribution of sex and/or gender to robots may differ according to the age, class, sex, ethnicity, and sexuality of the person doing the attributing [1, 94, p. 4]. These differences themselves are worthy of study. The possibility that the attribution of sex/gender to robots may be influenced by features of the attributor means that researchers need to pay attention to the demographics of their study cohorts.

### 5.2 Local Cultural Histories

Gender schemas and gender stereotypes, as well as larger cultural narratives about robots, differ between different societies and (sub) cultures. They also change across time within a society or culture. For this reason, the attribution of gender to robots may differ in different societies [1]. For instance, a robot that is—or is treated as—male or masculine in one society may be—or be treated as—female and feminine in another society. Some societies may be willing to attribute sex and/or gender to more robots or more willing to say of particular robots that they have sex and/or gender [52]. Differences between languages, and especially between those languages that mark the gender of nouns and those that do not, will also often be relevant here, such that the gender of

robots will be partially determined by the gender of the local term for “robot”.

It is important to recognise that different societies may differ both in regard to how they think about sex and/or gender *and* in regard to how they think about robots [119]. For instance, it is often suggested that Japanese culture is more open to a wider range of uses of robots and to the idea that robots have various qualities than most other cultures [1, 120, 121, p. 188; but see 122]. Appropriate choice of comparison cases should allow researchers to disentangle these factors should they wish to do so.

### 5.3 Environmental Cues

Previous work on the gendering of robots suggests that social and environmental cues play an important role in determining whether, and how, people attribute sex/gender to robots [95]. People may draw conclusions about the sex/gender of robots from the way that other people treat them. For instance, changing the name of a robot may change its sex/gender [123]. Similarly, placing a robot in a room filled with stereotypically “feminine” things may gender it differently than placing it in room filled with stereotypically “masculine” objects.

### 5.4 Use of the Robot

Because the actual use to which a robot is put may differ from its implied function as expressed in its design, stereotypes about jobs and social roles may be activated both by “them” and by “us”. Thus, the roles in which robots are employed may shape people’s perceptions of their gender [1, 86, pp. 2213–2230]. For instance, people may be more likely to identify a robot being employed in construction as male rather than female and a robot being used in a kindergarten as female rather than male.

## 6 Methodologies

The complex nature of the phenomena of robot sex and robot gender means that a number of different methodologies have the potential to reveal valuable information about the gendering of robots. While each of these methodologies is used by one or more researchers investigating the sex/gender of robots, each researcher typically uses only one or two of these methodologies. For this reason, it is important to highlight the full range of different methodologies available, as we do here: we also draw attention to the possibility that different methods will produce different findings.

## 6.1 Cultural Studies

Before robots existed, there were stories about robots. Books, plays, and films about mechanical men (and women), from antiquity to the science fiction of the 1930's-50's, established tropes about the nature and purpose of robots that remain influential today [124]. More recently, science fiction films about robots, or which include robots, from the "Star Wars" and "Terminator" franchises to various Pixar studios films, and popular television programs with robots as characters, such as "Humans", "Lost in Space", "Westworld", and "Knight Rider", have brought robots into the living rooms of the entire population [125–127]. Indeed, in some contexts, the power and prevalence of these narratives represents a serious problem for HRI by making it hard to distinguish between what people think about (real) robots and what they think about what they think robots are as a result of seeing them in science fiction. However, in the current context, because robots are cultural icons as much as they are real artefacts, and because stories about, and images of, robots shape the way people interact with (real) robots, analysis of films, books, and images of robots have much to tell us about their sex and/or gender [128].

## 6.2 Discourse Analysis

More generally, the way people talk and write about robots reveals information about the extent to which, and the ways in which, people attribute sex and/or gender to robots. Both popular and scientific texts about robots are a productive site for investigation of the gendering of robots via discourse analysis [5, 110, 129, 130].

## 6.3 Laboratory Ethnographies

Robots are shaped by those who design and build them. For this reason, the attribution, if any, of sex/gender to robots by engineers and roboticists is of especial interest. Laboratory ethnographies, wherein social science researchers work alongside those designing robots and observe how they think and talk about their creations, have the potential to generate insights into the sex and/or gender of robots and how it arises [131, 132].

## 6.4 User Attributions

An obvious, and not silly, way to determine whether, how, and why people attribute gender to robots is to ask them. Interviews with, and surveys of, users and potential users of robots about whether, how, and why they attribute sex/gender to robots in general and/or to particular robots may have much to tell us [133, 134, pp. 423–431]. Given that we regularly attribute gender to third parties, research performed using

images or video vignettes may have some utility here. However, insofar as it is possible that interacting with real robots in real contexts may change what people think and feel about robots, it will be vital eventually to conduct research using actual robots, rather than images of robots, and also research with robots and users "in the wild" (in actual use-settings) rather than in laboratories [11, 12].

## 6.5 User Responses

Notoriously, individuals' own accounts of their behaviour, and of the reasons for that behaviour, are unreliable [135–139]. Researchers interested in the gendering of robots can ill-afford to rest satisfied with what people say about their attribution of sex/gender to robots and will also need to determine how people actually behave around robots and what that reveals about how people think about the sex and/or gender of robots. Fortunately, a plethora of different methods for investigating how the attribution of gender to people impacts on the behaviour of the attributer have been pioneered by researchers in social psychology. It should be reasonably straightforward to adopt many of these to the investigation of the gendering of robots. Thus, for instance, researchers interested in the sex/gender of robots might design experiments to see how exposure to different robots activates (or fails to activate) gender stereotypes in tasks where these have been shown to play a role, such as the attribution of other traits [86, 140–142], response to social threat [143], willingness to trust [98, 144, 145, p. 482], or performance in implicit association tests [133, 146]. They might examine individuals' word choices and speech patterns as they interact with different robots for signs of attribution of gender [147]. They might also see how people change the orientation and location of their bodies in relation to robots and people around them ("proxemics") in the course of interactions with different robots [148–151].

## 6.6 Uptake

Because contemporary societies, and interpersonal interactions, are structured so deeply by sex/gender, the sex/gender attributed to particular robots, or kinds of robots, is likely to have implications for how people interact with them and thus to the extent to which they succeed in particular roles [152]. For instance, given the way in which notions of care are strongly gendered, robots that are perceived to be male or highly masculine may succeed less well in roles in which they are supposed to provide care, as a result of people's preconceptions. Conversely, then, the success or failure of different applications may tell us something about the sex/gender of robots.



## 6.7 Social Impacts

Finally, relatedly, as the past century of feminist activism has demonstrated, changes in how we understand sex/gender in one area of social life may have implications in another. For instance, as women demanded—and achieved—access to the paid workforce, society at large was forced to recognise that women possessed many qualities that had previously been held to be unique to men, which in turn opened up new possibilities for women and established new forms of femininity. In the future it may prove possible to trace changes in gender stereotypes or gender schemas back to the impacts of the introduction of robots, or of particular robots, and thus to draw conclusions about the latter from the former.

## 6.8 Can “the Folk” be Wrong About the Gendering of Robots?

An important theoretical consideration relevant to the interpretation of the results of investigations using these methods concerns their relative weight when it comes to settling the question of the sex, or gender, of robots. What if investigations in cultural studies or discourse analysis find that robots, or particular kinds of robot, are gendered but studies of the behaviours of users reveal that these cultural significations are moot, or mostly moot, at the level of the individual user? What if laboratory ethnographies show that the designers of robots don't think of them as having sex and/or gender but surveys of users suggest that users do gender them? A particularly thorny theoretical dilemma arises in relation to the weight we should give to first- person accounts of how users think about robots. What if some, perhaps even the majority of, users insist that robots don't have sex and/or gender despite the fact that the way that people talk with robots, or move around robots, or attribute other traits to robots, suggests that users *are* attributing sex/gender to robots? Were they to occur, such discordances in findings using different methodologies would require researchers to confront difficult questions about the ethical and/or political significance of different sorts of findings: it might also require them to think about the ontology of sex/gender.

## 7 Do Robots Have Sex?

Given that the relationship between sex and gender is so heavily contested, both at the level of theory and of politics, we have deliberately chosen to remain under committed on the question as to whether sex and gender are characteristics that people *attribute* to robots or whether sex, at least, might be a characteristic of some robots themselves. However, it is important to note that if, as an influential account of the nature of sex holds, to have sex is just to be treated as though one is

male or female (or intersex or non-binary) [43], and people do gender some robots, distinguishing between “male” and “female” (or intersex or non-binary) robots and relating to them differently, then those robots really will “have sex”. That is to say, some robots may be male or female (or intersex or non-binary) just as much—and in the same way—as human beings may be male or female (or intersex or non-binary) [1, 55].

The idea that robots have sex is most plausible if to be sexed is to be located in relation to a social schema regarding sex roles; that is, if sex itself is a function of gender. Interestingly, though, the possibility that (some) robots might themselves be sexed remains open even if we hold that sex is a function of bodies and not just social relations. One might plausibly hold, for instance, that to have sex is to have a body that other people would recognise as sexed were they to become aware of it [153, p. 80]. On this account, some robots, those that have genitals or (perhaps) other morphological features associated with sex, would have sex, whilst others would not. Robot anatomy—or, more precisely, people's response to the anatomy of a robot—would ground robot sex.

That anatomy might ground sex in a non-biological body is a challenging thought. However, as we noted above, the way we talk about robot “eyes” and “hands” suggests that robots may have other features that similarly might be held to be more typically biological. People and animals can be male or female while infants, or infertile, so it is clear that individuals need not be able to reproduce to be sexed. It is possible to garner support for the idea that it is anatomy, rather than other aspects of human biology, that grounds sex in human beings from contemporary attitudes towards sex-reassignment/confirmation surgery and genital prostheses. If the presence of a surgically constructed neovagina or neophallus, or regular use of a genital protheses, can establish that an individual is male or female, then it does not seem impossible that the genitals of robots might establish their sex.

It might be objected here that sex is a matter of self-identification rather than of recognition by third parties [68] and that, because robots do not identify as male or female, or have a “felt” sex, robots cannot have sex [1, p. 53, 52]. In fact, it is quite possible that some robots will announce their sex, or will name their sex if asked, if they have been programmed to do so [154]. More sophisticated machines, attuned to the complexities of human behaviour, might learn their sex from the way that they are treated by human beings and adjust their behaviour accordingly, resulting in something like “felt” sex [1, p. 56]. Nevertheless, given that there is little evidence that robots are likely to become sentient for the foreseeable future, if, in order to have sex, someone must have a conscious thought about their sex—or at least

a subjective experience of a certain sort—then it will follow quickly that robots cannot be sexed.

However, although there may be good moral and political reasons not to controvert what people say about their own sex, the idea that an individual's sex is determined by their own subjective self-identification is itself contested [65, 155]. There is a tension between the claim that sex is socially constructed and the idea that people have first person authority with regards to their sex: the social construction of sex implies both that there are (socially constructed) criteria for being male or female (or non-binary) and that the judgements of third parties are relevant to the determination of sex. Grounding sex in subjective experience also risks implying that human infants do not have sex and that the sex of human beings is radically different to the sex of non-human animals.

There are deep waters here and it is beyond the scope of this paper to try to resolve this issue—even if it were the place of the authors to try to do so, which it is not. Whether robots may have sex depends on the answers to questions about the nature of sex that are highly contested. Nevertheless, on some account of the nature of sex, robots may be male and female and not just masculine and feminine.

## 8 Media Ethics for Gendered Robots

Until—if they are ever likely to—robots become sentient, the ethical issues raised by robots will be confined to their impacts on human beings, other sentient creatures, and the environment. Many of the ethical issues raised by robots, including those raised by the gendering of robots, are best thought of as issues in media ethics. Robots are a new medium whereby people communicate and express ideas that may impact, and be evaluated by, other people. What one might call “Robot Media Ethics” is concerned with the ethics of this new medium.

One of the first question that arises in, and about, robot media ethics is whether there is anything distinctive about robots when it comes to how they—and their power to—express ideas, especially in comparison to representations of people (and animals) in other media forms like film and video games. Robots differ from representations in these other media by being embodied and sharing three-dimensional space with us; they can move around us and manipulate the real world, including touching us. There is some evidence that, as a result of our evolved psychology, we respond to robots as though they are alive [156–158].

It is sometimes argued that the embodied nature of robots means that they have more power to shape the attitudes and behaviours of their users than do other media. That is to say, robots have distinctive media effects. For instance, Belpaeme et al. [159] and Breazeal et al. [160], suggest that robots are more effective in training and education than film and/or

videogames. If this is true, then the ethics of use of robots as media might well differ from the ethics of other media. In particular, sexism in the attribution of gender to robots might be more problematic than sexism in film and computer games.

Another possibility, which is yet to receive adequate attention in the literature, is that the embodied nature of robots means that representation—the process whereby symbols come to mean something—functions *differently* in robots than it does in (most) other media forms [161].<sup>4</sup> In at least some contexts, robots may function as *icons* of a more powerful sort than other representations. An icon is a sign that shares properties with the thing it represents [162, 163]. Robots can share more properties with the things they represent than can other signs. For instance, they can share size, shape, volume, location in space, and perhaps even dispositions, with the things they represent. They also share other properties more fully with the things they represent than do other signs. Thus, for instance, while we might say of a photo and a robot that each represents a person with red hair, only of the robot will it be true that we can touch, or even cut, its hair. We might even say that the robot “has red hair” but that the photo is only a “photo of a person with red hair”. As we have seen, it may even be that one of the properties that (some) robots may share with what they represent is sex.<sup>5</sup> The fact that robots can serve as icons in this way might mean that representation of people by robots raises distinctive ethical issues.

### 8.1 Ethical Questions

Robot media ethics will be a more interesting and challenging field if these, or other, claims about the ways robots different from other media are true. However, regardless, robot media ethics will be necessary as long as people are building robots that convey ideas or are using robots to communicate with each other. At the very least, the gendering of robots will raise questions in media ethics regarding the following matters.

### 8.2 Stereotyping and the Reinforcement of Stereotypes

Where robots represent people, the design of the robot and how we respond to it may communicate something about those people. In particular, the attribution of sex/gender to

<sup>4</sup> Some of the claims that follow will also be true of sculptures, others of characters in videogames. Nevertheless, only of robots is the conjunction of the claims true.

<sup>5</sup> Elsewhere, one of the authors has argued that robots may also have race, which would then be another property that some robots might share with the people they represent. See Sparrow [93] and Sparrow [164].

robots may reinforce, at the same time as it draws upon, gender (sex) stereotypes that are themselves sexist and harmful [1, p. 56, 4, 88, 110, 165, 166]. For instance, if the nursing robots are all female and the surgical robots are all male, that will reinforce stereotypes about gender and medicine that will work to the detriment of women. However, in some circumstances, activating stereotypes may also assist designers in achieving their intentions when it comes to prompting certain user responses to robots [133, 167, 168].

Concerns about stereotyping are perhaps most pressing if the harms associated with it, which include an increased likelihood that people will apply the same stereotypes in the future, are understood as media effects. However, it is also possible to argue that some forms of stereotyping, at least, are morally wrong in-and-of-themselves [169, 170, p. 282]. Stereotyping may play a role in the design of robots or in user responses to robots and may be ethically troubling in both contexts.

### 8.3 Objectification

Whenever robots are used to represent people, or are taken to represent people, there is a risk that part of what is communicated through this act of representation is that such representation is appropriate. That is to say, in representing people using robots, we imply that those people are themselves relevantly like the robot—which is also to say that they are like *a* robot. Given that robots are paradigmatically *not* human, that they are machines that are designed to *serve* humans, and that, culturally speaking, at least in Western societies, robots are akin to bodies without mind or spirit, to represent someone as a robot is to dehumanise them [171, 172].

One way of cashing this out ethically is to say that there is a risk of objectification—of treating people like objects—involved in representing people using robots [173, 174]. Where robots have sex—and to a lesser extent gender—they represent men or women (or intersex or non-binary persons) and thus there is a risk that gendering robots objectifies people of each of these sexes. This risk is especially troubling when robots represent women, who have—indeed are still—often been reduced to their bodies, portrayed as servile and subordinate to men by nature, and/or implied to be less than fully human in other forms of media [175]. This larger cultural dynamic is one reason why, as Richardson [174, 176] has argued, concerns about objectification are especially pertinent to the design of sex robots. Again, it is here important to separate two superficially similar claims. First, it might be argued that the attribution of sex/gender of robots will *cause* people to reduce women—or, less plausibly, men—to their bodies: this is a media effects claim. Second, it might be argued that designing robots, or perhaps certain sorts of robots, so that they had sex/ gender itself just is an act of

objectification and morally problematic on that basis alone [177].

The ethical issues surrounding the risk of objectification involved in the design, or use, of robots are complex. It has proved difficult, in the larger debate about objectification in, and by, the media, to formulate a plausible account of objectification that also implies that objectifying people is always morally wrong: there may be times when objectification is appropriate, as, for instance, when sketching a life model, or perhaps even desirable, as when an individual wants to be physically desired by a lover [178, 179]. If (some) robots really do have sex, or users tend to gender robots against the wishes of designers, concerns about objectification may be moot: we don't typically criticise other people for objectifying us simply by virtue of attributing sex to us.

### 8.4 Ethics of Deception and Manipulation

If robots, can't, or don't, have sex or (although this is perhaps less likely) gender, but people are inclined to treat them as they do, then this will mean that users will often be mistaken about the nature of the entities with which they are interacting. If designers of robots encourage users to attribute sex to their robots, through their design choices, this would constitute deceiving and manipulating users: the ethics of deception via robots is a "hot topic" in robot ethics [180–183]. If—or, perhaps, where—robots do have sex/gender, given the extent to which sex and gender structure our social interactions with each other, conscious choices by designers about the sex/gender of their robots may constitute manipulation of users, which may also seem problematic in some lights.

### 8.5 Distribution of Responsibility

As per our discussion above, if robots have sex/gender, the sex/gender of robots will be the product of the responses—and to some extent the choices—of multiple parties regarding robots. The design choices of designers will play a large role in determining the sex and/or gender of robots, but so too will larger cultural narratives, social context (which itself will be partially constituted by the choices of other parties, including: academic researchers, funding agencies, teachers, hobbyists, and companies manufacturing and selling robots), and the responses of users. This problematizes the allocation of responsibility for the gendering of robots and for whatever wrongs it might involve or that might flow from it. For instance, should we hold the designers of robots responsible for user attributions of sex/gender? Even if designers have tried to prevent users from attributing sex/gender? Can we hold users responsible for attributing gender when gender schemas exist at the level of culture and are applied, at least in part, unconsciously? Discussions of these questions would benefit from the lessons of the larger

literature on the ethics of invention and of the responsibilities of engineers [94, 184, 185].

## 9 The World We Want... The World We Have

The ethical questions around the gendering of robots are connected to larger political questions about the nature and social role of sex/gender and about what justice looks like in a world that is characterised by systemic injustice (what philosophers call “non-ideal theory” [186]).

On some accounts, both sex and gender represent unjust limitations on the freedom of individuals [49, 51]. It shouldn't matter at all, when it comes to the question of how we should treat someone, what genitals they have, or how they speak, dress, or look. Consequently, a just society would not classify people by either sex or gender. On other accounts, though, sex differences are a form of human variation that a theory of justice must take into account: in a just society some social institutions would recognise sex [10, 187].

These different theoretical positions about the role of sex/gender in a just society are clearly relevant to, but do not necessarily determine, the question as to whether we should endorse or resist classification of people (and robots?) by sex and or gender in the unjust (sexist) world in which we currently live. Even if one thought that sex and/or gender would not matter in a just world, one might hold that that attempts to bring about such a world that ignore the ways in which sex and/or gender matter now are doomed [10, 188, p. 173, 189]. Alternatively, one might hold that justice requires that one works, for the moment, to disrupt and resist sex/gender classifications, because of the role they play in sustaining unjust social structures, even though such classifications will have a role to play in the world we are trying to create. What justice requires in the world we have (non-ideal theory) may differ from what justice would require in the world we want (ideal theory).

Whether engineers should build robots which mobilise gender stereotypes in order secure benefits for users [190], build robots which invert or subvert gender stereotypes in order to challenge sexist assumptions and social practices [1, p. 57, 88, 110, 165, 191, 192], or try to build robots that are not gendered at all [193, p. 22] cannot be settled without taking a position on these larger political questions.

## 10 The Contribution of HRI to Gender Studies

We have argued that, because sex and gender structure social relations so deeply, and are, as a result, so heavily contested, designing valid and objective studies of the gendering of robots will require HRI researchers to collaborate and

learn from researchers in gender studies and critical theory. Designing robots, and making policy about the use of robots, in the light of the findings of this investigation will require engineers, and policy makers, to engage with applied ethics and philosophy in order to confront difficult ethical and political questions.

Given the complexity, and fraught nature, of these questions, we suspect that this conclusion may be the cause of some discomfort within the engineering community. It may, we hope, be some compensation that HRI has the potential to offer much to researchers in these other fields [52]. The embodied and programmable nature of robots means that robots offer a unique opportunity to conduct controlled experiments to see what factors shape the assignation of sex/gender. As, we would like to believe, our own discussion here serves to demonstrate, thinking about sex/gender in the context of bodies that are entirely artefactual sharpens key questions in the larger cultural and philosophical debate about the nature of sex and gender and, as such, may help progress these debates. In the long run, the design of gendered robots may offer opportunities to intervene into these debates and to shape the way we understand sex/gender in the future.

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### Declarations

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**Robert Sparrow** is a Professor in the Philosophy Program, and an Associate Investigator in the Australian Research Council Centre of Excellence for Automated Decision Making and Society, at Monash University, where he works on ethical issues raised by new technologies. He has served as a co-chair of the IEEE Technical Committee on Robot Ethics and was one of the founding members of the International Committee for Robot Arms Control.

**Eliana Horn** is currently a doctoral candidate at Monash University. She is examining various normative and epistemological questions surrounding the use of social justice promoting virtual reality.

**Friederike Eyssel** is Professor of Psychology and head of the research group “Applied Social Psychology and Gender Research” at the Center for Cognitive Interaction Technology (CITEC), Bielefeld University, Germany. Dr. Eyssel is passionate about basic and applied social psychological research and she is interested in various research topics ranging from social robotics, trust, and acceptance of novel technologies to attitudes and attitude change. She is co-author of various textbooks on social robots, among them “HRI: An introduction (2020, Cambridge University Press), “Robots in Education” (2021, Routledge), and “Theory and practice of sociosensitive and socioactive systems” (2022, Springer).