Intimacy, Bonding, and Sex Robots: Examining Empirical Results and Exploring Ethical Ramifications

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1 Introduction and Motivation

Many advances in communicative technology have served to represent and express human sexuality: the printing press, motion pictures, and, not the least, the Internet. Social robotics, however, while not yet a mainstream contributor, is particularly poised to represent, enact, and affect society's sexual mores and practices. Sex robots are already manufactured and marketed by several companies, with increasing variety and capability being at least promised if not delivered.[1] And although virtual reality and other computer-based avenues for sexual use are also developing rapidly, sex robots—embodied, mobile, and (to a limited degree) expressive—elicit and trade upon dimensions of physicality, intimacy, reciprocity, and social space. Robots both reflect and refract notions of what human bodies are, how they interact, touch, desire, and accompany one another. The prospect of sex robots assuming a greater presence in our societies underscores the general ethical questions raised by social robots: How will people be able to live with such robots? How will people treat each other as a result? Will social robots replace human beings in ways they should not?

In the last decade, scholars have begun to draw together and analyze major issues at the particular intersection of robots and sexual ethics. Levy explores how robots could meet and transform human sexual needs, possibly beneficially.[2] A range of perspectives across philosophy, psychology, and computer science—from generally appreciative to deeply skeptical—have sought to spell out how love, vulnerability, and other emotional facets of sexuality could make sense in human-robot contexts.[3] More recently, debates have heated up over to what degree sex robots could exacerbate the exploitation of women, in particular sex workers.

What these discussions have so far lacked is a systematic empirical survey of people's opinions, however familiar they may be with the technology or its challenges. While polling does not settle ethical debates, arguments with empirical assumptions about people's social views and reactions toward social robots should not remain untethered by actual views of the public. Seeing where those opinions lie can help to describe the society into which new developments in robotics may be introduced, perhaps by flagging important moral intuitions that could affect how the use of sex robots will unfold on a societal level (for example, who presently would be likely to use them and for what purpose). It can enhance ethical arguments to consider how a number of actual people currently regard the notions being discussed.

To that end, we recently presented the first systematic survey of views on the use of sex robots.[4] Inquiring as to what kind of uses, forms, and context would be appropriate or not for sex robots

we found significant differences of gender and interesting points of convergence. In this chapter, we present and discuss the results of a second survey, which expands upon our initial survey with additional questions about possible advantages and disadvantages of sex robots. We show our second survey generally reproduces the gender differences highlighted by the first, and also reveals important shared senses for how robots affect relationships in society. We explore in closer detail some of these specific takes, and surmise that ethical discussions of sex robots must facilitate finer-grained discussions of relationships and context than have been conducted so far. In particular, we conclude that notions of intimacy and companionship—inherent in social robotics in general—must overtake narrower discussions of sexuality, robots, and "sex robots."

2 Background

Sex robots, however their development will proceed going forward, are a present-day reality.[5] It is on the basis of products like Roxxxy and others (particularly in Japan) that some have gone so far as to forecast human-robot sex will overtake mere human sex by 2050.[6] And in this light, some commentators have imagined a much greater range of offerings for robotic sex, for example, ones more geared to women.[7] Perhaps sensing that the market might take shape more quickly than any ethical resolutions, SoftBank took the measure of requiring users to promise not to use its social robot Pepper for sexual purposes (McCurry, 2015).

Still, there has been considerable scholarly effort to catch up to where these products promise to lead. Levy's sustained treatment *Love and Sex With Robots* factors in a wide array of contexts and genuine sexual needs that robots could serve. Others have sought to tease out how love, companionship, and vulnerability may factor into a person's attempt to create sexual intimacy with a robot.[9] There has also been a more applied

comparison of how sexual interaction could serve legitimate needs when viewed along- side other contexts of social robotics.[10]
More recent momentum in the ethics of human-robot sexual interaction has built upon the threat of increased exploitation of human beings. The *Campaign Against Sex Robots* has featured strong articulations of how sex with robots could degrade respect for human sex workers, if not women more generally.[10] Such a stance has resonated with legal arguments that human-robot sex could erode notions of consent within society as a whole,[11] along with cultural criticism that views robot design as geared to meet heterosexual male needs, including sexuality, almost exclusively.[12] The prospect of an abusive backlash toward human beings has led to careful sorting of what type of sexual behavior causes what kind of social harm.[13]

Not yet fully integrated into such discussions is relevant work in human-robot inter- action (HRI) on intimacy and bonding, which suggests that social robots—sex robots included—could induce powerful, if manipulative, expectations of reciprocity and connection.[14] Other empirical work in HRI suggests that even basic forms of touching, whether by or of a robot, may arouse a person in certain contexts.[15]

Despite these contributions, ethical discussions of sex robots have lacked any survey of what people actually think about their use. We recently presented the first survey of that kind, asking

through Amazon Mechanical Turk about appropriate uses, forms of robot, contexts for use, and whether one would oneself use a sex robot (Scheutz and Arnold, 2016). We found significant differences in how appropriate men and women regarded using a sex robot, with men more approving and women less so almost across the board. On the other hand, men and women shared a general sense for what capabilities a sex robot would have, a particular form that would be inappropriate (e.g., child), and certain contexts where a sex robot would be more appropriate than not (e.g., extreme isolation, sexual harassment training).

In order to build on this initial sketch, we sought a survey that could look in closer detail at what aspect of sexual interaction with robots informed people's judgments on their use, both for individuals and society at large.

3 Methods

We employed the overall design, materials, and procedure from our HRI (Human-Robot Interaction conference) 2016 survey, with a few extensions we will briefly summarize below.

Materials: The survey consisted of several parts. The first and the last part consisted of the same sixteen background questions about possible capabilities of sex robots in order to better understand how people construed sex robots in terms of their proper- ties and capabilities, and to ensure that subjects answered those questions carefully; significant differences in answers before and after the other parts would either indicate that subjects changed their minds or that they did not pay attention to the questions in the first place. The second part consisted of fifteen questions on what subjects took to be appropriate uses of sex robots, while the ten questions of the third part were aimed at allowable physical forms for sex robots. Part four then asked eleven questions about possible advantages of sex robots, followed by part five with eight questions about possible disadvantages, and part six with eleven questions about subjects' general views on sex robots. Note that we specifically refrained from priming subjects with either images or descriptions of sex robots, or suggestions of what it might mean to have sex with a sex robot. We also intentionally did not include any definition of "sex" for the same reason, i.e., to allow subjects to express their own views through their selection of answers.

Participants: We recruited 203 US subjects from AMT; five were eliminated due to incomplete data, leaving 114 males and 84 females. Their overall mean age was 34.11 years, with male mean age being 34 and female mean age being 34.24 years. The minimum age was 18, the maximum age 63 years. None of the participants had participated in the study before.

Procedure: Before the experiment began, participants were informed of the purpose of the study, namely to collect information about their views on sex robots, and they were also warned that they might find some questions emotionally disturbing. Once informed consent was received, a basic demographic questionnaire with subject age and gender had to completed. Then participants were shown the above-described parts in order, with questions within each part randomly rearranged to avoid any possible order effects, and with one question asked at a time.

4 Results

We start with a comparison of the current experimental results with the HRI 2016 survey results for (1) the expected capabilities of sex robots; (2) appropriate uses of sex robots; and (3) allowable forms of sex robots. Then we present new data on subjects' views regarding possible advantages and disadvantages of sex robots, as well as general statements about sex robots.

4.1 Expected Capabilities of Sex Robots

Table 1 shows the background information from the HRI 2016 study, as well as the before and after ratings of the current study. Overall subjects' construals of sex robots' properties are very similar, both compared across the two studies, as well as compared within the current study. Note that that before and after background data in the cur- rent survey are similar to within 10%, suggesting that subjects read the questions care- fully and consistently answered them, with a slight bias possibly toward being more inclined to attribute cognitive abilities such as "can recognize objects," "can under- stand language," or "remembers past interactions" in the post-survey ratings compared to the pre-survey ratings.
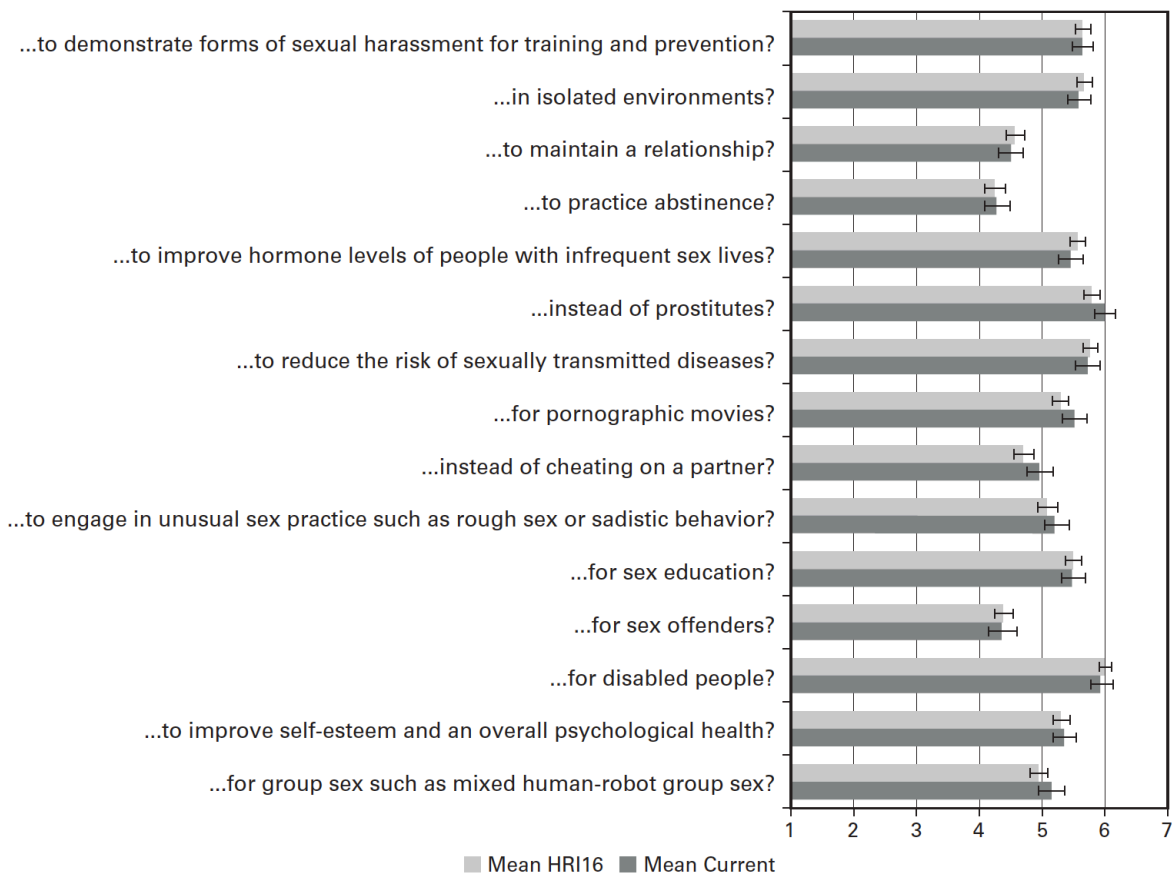
4.2 Appropriate Uses of Sex Robots

Figure 1 compares subjects' ratings of appropriate uses of sex robots in the HRI 2016 study and the current study. As can be seen by the overlapping standard error intervals, there is no significant difference between subjects' ratings of appropriate uses in the

Table 1
Background questions about the subjects' views on what sex robots are capable of, and percentages of subjects who agreed with the capabilities on the HRI16 data before the current and after the current sex robots questions.

| Is Robot Capable of Attribute	% HRI 2016	% Before	% After
Can hear.	38	44	49
Can see.	36	39	43
Can recognize objects.	44	46	52
Can understand language.	49	52	61
Can talk.	53	51	57
Can remember past. interactions	37	45	55
Can be instructed.	78	84	86
Can learn new behaviors.	49	59	63
Moves by itself.	79	77	74
Adapts to human behavior.	53	52	59
Recognizes human emotions.	20	26	24
Specifically designed to satisfy human sexual desire.	86	92	85
Can take initiative.	27	22	26
Has feelings.	11	7	10
Responds to touch.	64	68	69
Obeys orders.	69	79	81

Figure 1
Comparison of appropriate uses between HRI 2016 data and the current data showing that there are no significant differences in subjects' views of appropriate uses. Ratings are on a scale from 1= "completely inappropriate" to 7= "completely appropriate." Error bars depict standard errors.

two studies. The current study does perfectly replicate previous findings about appropriate uses of sex robots.

4.3 Appropriate Forms of Sex Robots

Figure 2 compares subjects' ratings of appropriate forms in the HRI 2016 study and the current study. As can be seen by overlapping standard error intervals, there is no significant difference between subjects' ratings of appropriate forms in most cases in the two studies, except for "fantasy creature," which the HRI 2016 rated as slightly more appropriate. However, given that the difference less than 0.5 on the scale of 7,
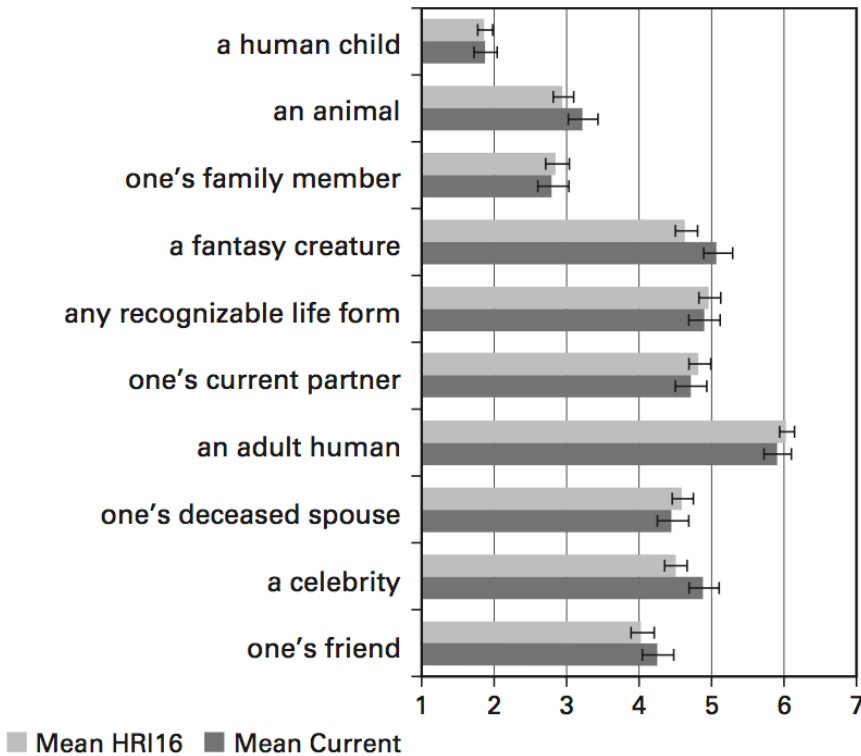
Figure 2

Comparison of appropriate forms between HRI 2016 data and the current data showing that there are no significant differences in subjects' views of appropriate forms. Ratings are on a scale from 1="completely inappropriate" to 7="completely appropriate." Error bars depict standard errors.

and both ratings are clearly on the appropriate side, this small numeric difference does likely not signify any important difference overall in conceptualization, thus showing that the current study also replicated all HRI 2016 findings for appropriate forms of sex robots.

4.4 Possible Advantages of Sex Robots

Table 2 shows the percentage of subjects agreeing with the various possible advantages of sex robots. Not surprisingly, most agreement is obtained with questions about the prevention of disease transmission, sex availability around the clock, and the lack of psychological impact on the sex partner. Similarly, people disagreed with sex robots possibly enabling legal underage sex. Opinions were more split on questions the effects of sex robots on people's sex lives, as well as emotional and physical harm.

4.5 Possible Disadvantages of Sex Robots

Table 3 shows the percentage of subjects agreeing with the various possible disadvantages of sex robots. Except for people's strong disagreement with their possible

Table 2

Questions about the subjects' views on the possible advantages of sex robots, and percentages of subjects who agreed with the possible advantages.

Advantages	% Agree
No disease transmission.	92
Sex is available anytime.	80
No psychological impact on the sex partner (i.e., the robot).	72
No physical pain suffered from human behavior.	62
Allow people to expand their sexual horizon.	59
Provide people with companionship.	59
Improve people's sex lives with other people.	54
Allow people to experience better orgasms.	47
Cheaper sex.	43
More predictable and less clumsy physical behavior, meaning less injury.	41
Underage sex is possible and legal.	19

Table 3

Questions about the subjects' views on the possible advantages of sex robots and percentages of subjects who agreed with the possible advantages.

Disadvantages	% Agree
Might harm relationships with other humans (e.g., abusive, controlling, hatred for other humans).	70
Sex with the robot will become addictive.	68
Transfer unrealistic expectations to humans, leading to disappointment or abuse.	66
Robots could hurt people if they don't function right.	58
Emotional bonds might form beyond the sexual act.	40
Take out frustrations with robots onto humans.	33
The robots might be too good, people won't go back to humans.	32
Robots will be able to exploit people.	6

exploitation by sex robots, the overall ratings here are not as strong as with the possible advantages. People somewhat agree that sex robots could cause harm to human relationships and might be addictive, possibly leading to unrealistic expectation in the human case. And they slightly disagree that sex robots might become so good that people will not go back to human sex, although this is, of course, a speculative question, since we cannot know whether this is true without having advanced sex robots.

4.6 General Views of Sex Robots

Table 4 shows the percentage of subjects agreeing with various general statements about sex robots. The strongest agreement (which was overall fairly modest) was that sex with a sex robots

does not violate any law, while the strongest disagreement to any question was about whether sex robots ought to have rights: only 6% of all subjects agreed with this statement. Overall, we found a split on questions such as whether one could fall in love with a sex robot, whether a sex robot must always oblige or should only be used for sex, whether any action is allowed with a sex robot, and whether one can cheat with a sex robot. Again, subjects did not agree with underage sex with a sex robot being legal, and they most disagreed that sex robots would free humans from human sexual relationships. Interestingly, and different from the HRI 2016 data where subjects found sex with a sex robot more like masturbation than having sex, subjects in the current

Table 4
Questions about the subjects' general views on sex robots and percentages of subjects who agreed with the statements.

True of sex robots	% Agree
Having sex with a robot does not violate any law.	71
One cannot rape a sex robot.	62
People could fall in love with sex robots.	50
A sex robot must always oblige and should never reject a person.	47
A sex robot should only be used for sex.	44
Any action (e.g., hitting), including dismantling it, is allowed with a sex robot.	42
One cannot cheat on a human with a sex robot.	40
People will treat a sex robot like a human lover.	37
Sex robots will free human relationships from sexual pressure.	32
Sex with a sex robot is not really sex and does not count as sex.	30
Underage sex with a sex robot is legal.	22
Sex robots should have rights.	6

study disagreed more with the idea that sex with a sex robot is not really sex and does not count as sex (we will return to this discrepancy shortly).

5 Discussion

The current study almost perfectly replicated overall findings from our previous HRI 2016 study on appropriate forms and uses of sex robots. Looking over the results with respect to possible advantages and disadvantages of sex robots, as well as general statements about sex robots, the priority of human social relationships could have determined the places where subjects were either strongly in agreement or strongly in disagreement with the statements.

To begin with, the advantages of sex robots mostly strongly identified involve the avoidance of harms and inconvenience, like disease, infrequency, and pain (whether physical or psychological). Next are benefits arguably more geared to the human participant alone (as

opposed to another human partner), though companionship and expanded sexual horizon feed into similar support for "improving sex lives with other people" (59% approving). While some have argued that robots could help educate the young in their incipient sexuality, there was decided disapproval of that as an advantage (only 19% approving). Use in the context of adult sexual lives that help oneself and others seems safer ground.

The disadvantages reported go hand in hand with the idea that harm/benefit to relationships, not to individual users alone, is the prime ethical benchmark in judging sexual interaction with robots. The strongest agreement dealt with the risk of abuse of other human beings, harming relationships through malformed expectations, frustration, or disappointment. Even the identification of sex addiction, while putatively about the "addict," could be as easily associated with relationships threatened by such addiction as the experience of the individual alone.

Interestingly, some common ideas about bonding and robot interaction in the scholarly literature and the mainstream press do not seem shared by the subjects. Emotional bonding beyond sex with the robots is not, for example, a threat most subjects shared, nor the risk that superior robot performance will render human-human sex inferior (making the 2050 prediction from the literature seem even bolder). Moreover, the idea that the robot will exploit the human is almost wholly rejected. Whether these last results say more about the presumed state of the technology on the part of the subjects, or speak to a more permanent skepticism that humans could fall prey to robot manipulation, is still an open question.

Finally, the feedback from the general statements about sex robots is arguably hazier than that of advantages and disadvantages, though there are points to note and more to flag for follow-up. For one thing, the attribution of agency to the robot seems muted, which suggests that future debates around social robots need to specify how "autonomous" the social robots in question will be. Robots are not thought of as able to exploit the human with whom they interact. This matches a refusal to think of robots as having rights, another interesting empirical check on some future projections or assumptions about anthropomorphism and legal rights.[17]

More broadly, these results bear upon an implication from our previous study: the ethical challenge of "sex robots" may hinge as much on the social and relational dynamics that overlap with sexuality than human-robot sex per se. As noted, the impact on relationships appears to thread through many of the responses about advantages and disadvantages of sex robots, but the implied attributions to robots make the connection between the human-robot interaction and relationships hard to pin down. On the one hand, while the most agreed-upon advantages involve the lack of physical harm a robot partner would receive or give (e.g., disease, emotional pain), it is notable that companionship, as much as improving a person's sex life, gets rated an advantage. And while disappointment and abuse toward human beings seems part of the overall disadvantage of relationship harm, there is a split over whether emotional bonding or falling in love with a robot could be at work.

The general views are likewise muddled on robotic consent, confined roles for sex robots, and what "sex" and "cheating" mean with respect to human-robot interaction. Close to half of the respondents thought a robot should "oblige" and not resist interaction, but what interaction they should be obliged to perform is harder to settle. Fewer than half thought the sex robot should only be used for sex, while fewer than half agreed that any action should be allowed toward the

robot. Fewer than half ruled out "cheating" on a human being with a robot, and even fewer thought sex with a robot did not "count" as sex (though that in part may be due to not being given alternative construals like "masturbation").

Thus, to the degree human relationships are the ethical arbiter for sex robot usage, there seem to be more complex attributions and contexts at work in sorting out how those relationships will be affected. The role of physical and emotional intimacy, which sexuality can involve but by no means entails in and of itself, could merit more specific attention as a possible aspect of robots used in many social contexts. Likewise, the dynamics of bonding, which may involve gratitude for work or solidarity on a shared goal, may fill out a more useful picture of how human-robot interaction can reshape what is fulfilling and disappointing with respect to human relationships. The themes of intimacy and bonding may also draw out more explicit moral judgments about the limits and tradeoffs that such interaction carries. For both future research and design, it will be important not to let powerful forms of expectation and interaction go under the radar out of undue concentration on more sensational forms (sex robots, lethal autonomous weapons, etc.). In other words, the real problems with sex robots may be as much their sociality as their involvement with sex.

6 Conclusions

The ethics of human beings sexually interacting with robots demands more than a one- to-one application of sexual ethics into the form, function, and setting of automated, embodied systems. The interaction between human and robot, along with its effects on human relationships, may produce novel dynamics, risks, and benefits; accordingly, such interaction may need to be held to new standards of scrutiny. Identifying those emerging phenomena, and composing sufficient ethical measures to hold them to societal account, will involve more than imagining possible scenarios technological innovation makes possible. It will also mean keeping close empirical tabs on how people react, both in reflection and—where possible and appropriate—actual physical interaction, to social robots in many capacities.

Acknowledgments

Notes

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