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Confronting Emerging New Technology: The Case of the Sexbots

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Robot Sex: Social and Ethical Implications. John Danaher and Neil McArthur (Editors). Cambridge, Massachusetts: MIT Press, 2017, 328 pages, $40.00 hardcover.

Robot Sex: Social and Ethical Implications is a collection of fifteen essays, most of them on ethical and social issues raised by the alleged advent of a technology that makes possible genuinely intimate sexual relationships between adult humans and robots. This review will concentrate on some large-scale systemic problems with this project, as these are instantiated in this set of essays. The failures of this collection are instructive for a better way, perhaps, to confront emerging new technologies.

Intimacy, the Ontic Status of Sexbots, and Evidence: Identifying the Target

John Danaher defines sexbots twice in his introductory essay, noting that they are essentially humanoid, human-like in their movements and behavior, and possessed of "some degree of artificial intelligence, i.e., it [the sexbot] is capable of interpreting and responding to information in its environment" (pp. 4-5). Later he gives a more succinct and slightly different definition: "They are robots with humanlike touch, movement, and intelligence that are designed and/or used for sexual purposes" (p. 12). The move from "some degree of artificial intelligence" to "humanlike … intelligence," is noteworthy, as the latter signals the presence of what current artificial intelligence research calls "general human level artificial intelligence." As we will see, this is very problematic for the project that is central to this book. A later chapter in the book declares:

> …there is good reason to think that *future* sexbots will be artificially sentient and artificially intelligent. Such robots would not just *seem* to experience pain or pleasure, they *would* experience it; they would not just *act* like they have deeply held goals and values, but they would *actually* have them. (Steve Petersen, chapter 9, p. 155)[1]

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[1] This is one of the more scandalous passages in the book. Petersen claims here also that "the possibility of genuine AI wins wide consensus among professional philosophers." But he only cites two others (besides himself). It is doubtful there is any such wide consensus.

We should also allow that such sexbots will be mobile and agile enough to mimic and engage in human-like sexual behavior, and have a power system adequate to doing so for appropriate time periods. This view of sexbots as artificial persons is gaining traction elsewhere in discussions of the alleged social impacts of such technology (see Cheok, Levy, Karunanayaka, and Morisawa, 2017; Mackenzie, 2018).

The present volume holds that such robots are imminent, either already extant or soon to be so, though occasionally there is some confusion about their ontological status. Thus chapter 10 (by Joshua Goldstein) holds that they will be capable of being our friends, and even of sustaining marriages. Chapter 11 (Michael Hauskeller) holds that they will be persons (p. 203), though a little later says maybe not. Chapter 14, by Julie Carpenter who is a computer scientist, holds that sexbots are "actors and sentient" (p. 262), that they have a point of view (p. 271), and genuine subjectivity, "a way of knowing the world" (p. 272). They are described as "a human-like thing" (p. 263), and even when said to be only "the illusion of a human partner" the emphasis is nonetheless on their similarity to humans. Carpenter goes on to say that sexbots will be as "indistinguishable from a human as a healthy person" (p. 280). John Danaher, in chapter 7, however, denies that sexbots are or ever will be persons (p. 106; cf. Danaher, Brian Earp, and Anders Sandberg in chapter 4, p. 55 similarly). So the view is not absolutely uniform, but tends to be towards what we might call the high end of robotic personhood. Only such a view makes sense out of the concern in chapter 9 (Steve Petersen) for ethical treatment of the bots themselves, and chapter 10's (Goldstein) view that sexbots are full moral agents. Chapter 12 (Sven Nyholm and Lily Frank) also holds that there can arise genuine love between a sexbot and its human partner. And, virtually everywhere in this collection we are assured again and again that they are imminent, if indeed not already extant.

It is thus not surprising that possession of human-level artificial intelligence is a prominent element in Danaher's definitions of "sexbot." For it is this kind of software that controls the robot's movements, gestures, body language, facial expressions, verbal expressions, capacity for engagement with human partners and for maintaining vital emotionally close relationships with them. In sum, sexbots, as defined here, have an operating system (whether or not lodged within the robot's body) capable of creating and maintaining intimacy with humans. There is an especially useful and concentrated discussion of artificial intelligence in chapter 12, pp. 219–237, the emphasis of which is on the incremental development of such artificial intelligence towards that goal (pp. 219, 220, 229, 233, 235, 237). It is as if we have only to await the continued gradual increase in the quality and power of artificial intelligence systems for such sexbots to appear. So, what is required for intimacy, according to our authors? This is one aspect of the book that is actually done quite well.

There is nothing inherently intimate about human sexual behavior. Indeed, as we know to our cost, sex can be deeply alienating. Nevertheless, good sex, it is widely agreed, promotes, expresses, and maintains intimacy between humans. *Robot Sex* strongly delineates many conditions of such intimacy. It involves shared agency (p. 19), exchange, especially in conversation (p. 21), mutual autonomy (and thus some capacity to refuse to be partners: p. 24) and the consent of both parties is also required (pp. 96, 105–106). Moreover, our authors have a very high view of what constitutes love: it is dispositional and intentional and not merely a matter of emotions (p. 225); it is highly reciprocal and involves mutual goodwill (p. 232). Chapter 12 engages in detailed discussion of the notions of a good match, of mutual valuing by both partners, and of commitment, as also involved in intimate partnerships. All this is good, and underscores deeply the extent and sophistication of the artificial intelligence that would be needed to support genuine intimacy between humans and robots. Indeed, the higher the view of such intimacy-conditions the more urgent the demand for artificial intelligence at a general human level.

There are some other views of intimacy in this collection that are less welcome. The absurd myth of original androgeny for humans — the loss of which is blamed for our constant search for our "missing half"— found in Aristophanes' speech in Plato's dialogue *Symposium* (189c 2 – 192d 5), for example, rears its ugly head twice (p. 227 and footnote 35, p. 180). Martin Buber's thesis that there are only two basic attitudes to take towards the world enters into the chapter on religious views of sex with robots (p. 99). That seems preposterous, as there are many other possible attitudes to take towards the world (e.g., paranoia, Machiavellianism, naïve universal trust in strangers). Goldstein's chapter on natural law holds that when humans engage in sexual intercourse they literally become a single organism (p. 178). And yet, if that were true, then those humans would also have a single circulatory system, which they do not; they would have a single endocrine system, which they do not; they would have a single neurological system, which they do not, and so on. In a discussion of empathy as a vital aspect of intimate relationships, that same author holds that empathy promotes an ever-expanding circle of persons in its purview. But recent critical examinations of empathy argue that such expansion is not inherent in empathy and not always preferable (Bloom, 2016, pp. 129–164; Oakely, Knafo, Madhavan, and Wilson, 2012, chapters 2, 9, 22, 25, and 28; discussion in Pinker, 2011, pp. 573–592). And while this review agrees that love is not principally a matter of emotions, the emotions should not be left out of consideration, as they plainly are heavily implicated in human intimacy. Moreover, recent developments in robotic emotions, i.e., the capacity for robots to detect, categorize, and respond appropriately to human emotions, and to express at least simulations of those same emotions, would go some distance towards strengthening the view of sexbots that pervades this volume, by rooting it in contemporary empirical scientific literature. This is worth exploring further, if only to indicate the extent of the evidence that is available.

Recent treatments of robotic emotions emphasize the role of "deep learning" in the emerging technology (Barros, Jirak, Weber, and Wermter, 2015; Barros, Parisi, Weber, and Wermter, 2017; Ruiz–Garcia, Elshaw, Altahhan, and Palade, 2018). And although our collection hints at the importance of deep learning for sexbot technology (pp. 231, 265, 268), it fails to exploit this and gets nowhere near these recent developments. In a parallel development, robots are now capable of surprise (Maier and Steinbach, 2010; Zenkoyoh and Tomiyama, 2011). Surprise is one of the basic human emotions (Carruthers, 2017; Ekman, 1992), and plays a substantial role in human sexual intimacy (Katehakis, 2017). But these relevant developments go unmentioned in *Robot Sex*. Similarly, as we saw, Danaher's definition mentions touch, but no one seems to know how to exploit this, either. But touch is enormously important in human intimacy (Gallace and Spence, 2010; Hertenstein, Holmes, McCullough, and Keltner, 2009; McGlone, Wessberg, and Olausson, 2014) and occurs by way of distinctive neural pathways (Löken, Wessberg, Morrison, and McGlone, 2009). Recently, robotic touch has become so refined it can distinguish degrees of ripeness in a fresh tomato (Zhao, O'Brien, Li, and Shepherd, 2016). Robotic actuators have now been developed with sophisticated capacities to mimic human musculature (Acome, Mitchell, Morrissey, Emmett, Benjamin, King et al., 2018). All this is highly relevant to the development of robots capable of genuine sexual intimacy with human partners. But it seems to be largely unknown to our authors. And this brings me to a major complaint about this set of essays.

Robot Sex is almost devoid of direct engagement with technical scientific, engineering, and robotics literature. Only four of the fifteen essays do so at all, with four references in the introductory chapter, one reference in chapter 12 (and it is to a work twenty years old), two references in chapter 13 (Matthias Scheutz and Thomas Arnold), and perhaps five references in chapter 14 (Carpenter). There are some indirect references in so far as both chapters 12 and 14 refer to secondary sources which themselves make direct contact with those literatures (Julie Carpenter's essay repeatedly refers us to her 2016 book on the use of robots in military applications, the reference list of which is replete with technical literature; I regret that the book itself was not available to me). All the rest are completely without any such references, whether direct or indirect. The essays are thus woefully absent sustained encounters with the relevant technical literature. This seems to me very unfortunate indeed. We are invited to consider numerous empirical claims about robots and their capacities for sexual intimacy with humans. But we are given very little direct empirical support for those claims. This is not the way to proceed, as Danaher, at least, knows perfectly well: see his plea in chapter 7 for "an experimental approach" to the whole business of sexbots and their implications (pp. 120–125; McArthur hints at something similar on p. 38, but steps away from it), and his final cry in that essay: "What we lack is data" (p. 126). The irony of that cry is severe in the setting of these essays. It does not matter that most of these authors are not scientists or engineers. They are perfectly capable of finding this literature, and of making more use of it than they do. If they did, they could strengthen their own arguments considerably. But a more basic problem looms.

Sexbots: Real, Imminent, or Merely Imaginary Companions?

It is alleged by some of the authors in *Robot Sex* that sexbots are already among us. This chiefly rests on claims made about Roxxxy, a product of a United States firm, True Companion. The firm Abyss Creations also enters the picture as having promised to release a genuine sexbot, called RealDoll, in 2017. However, neither of these products is a real sexbot, because they are almost nothing like what is defined as such here. Indeed, there is good reason to doubt that Roxxxy even exists, as actual owners of such have proved very hard to find (Kleeman, 2017a, 2017b). And no one has seen any robot at all from Abyss Creations. What these manufacturers are actually producing is sex dolls with at most a few additions. And while some humans (evidently mainly male) enjoy sexual conduct with these dolls, this is nothing more than masturbation and of a type well known since the appearance of sex dolls in the seventeenth century. Danaher is himself unconvinced ("I remain agnostic": p. 7) but also calls these putative bots "current sex-robot prototypes" (p. 106), as does Litska Strikwerda in chapter 8 (p. 127, fn. 15; pp. 134, 143–44). Everyone should be much more skeptical. And in no case is there the slightest evidence that anyone has actually produced even an elementary early version of what Danaher has defined as a sexbot and what his fellow writers here require a sexbot to be. In particular, no one has an artificial intelligence system capable of supporting genuine intimate love relationships between a robot and a human. But could there ever be real sexbots, as defined? I am inclined to doubt it, and here is why.

Besides the shortage of empirical support marshaled in these essays, we have also to consider especially the current state of artificial intelligence research and development. Sexbots, as here defined, need general human level artificial intelligence. And there is no general human level artificial intelligence available today. Despite considerable advances in the ability of artificial intelligence systems to analyze large sets of data, to extract patterns from that data (e.g., object recognition/categorization), even to plan strategically in games like chess or Go, played against human masters, artificial intelligence today falls massively short of human level intelligence. And this is one large reason why there are no actual sexbots available today. But what about the near-term future? *Robot Sex*, after all, repeatedly assures us that sexbots are imminent (explicitly at pp. 12, 43, 66, 134, 143, 155, 247; implicitly at pp. 23, 55, 175, 190, 219–220, 262, 263, 265, 271, 280). Perhaps the enabling of general human level artificial intelligence will itself be available soon. But, judging from recent expressions of the opinions of experts in the field, this is actually very unlikely. The task is simply way more difficult than anyone thought it would be (see popular articles by Lu, 2016 and del Prado, 2016; more technically in Davis and Marcus, 2015 and Lemaignan, Warnier, Sisbot, Clodic, and Alami, 2017). Davis's statement, quoted in Lu (2016), is especially clear that the development of AI is "…still light years behind the average 7-year-old in terms of common sense, vision, language, and intuition about how the physical world works." In a series of polls of experts carried out in 2013 and reported in Müller and Bostrom (2016), when asked to estimate how long it might be before general human level artificial intelligence is achieved, 41% thought more than 50 years, and 41% thought "never." When asked how long it might take for us to so well understand the workings of the human brain as to be able to model it adequately on a machine, 21% replied "within the next 50 years," 29% thought "in 100 years or more," and 21% thought "never." There is thus a very strong opinion among experts on artificial intelligence development that what would be needed for genuine sexbots is unlikely to appear anytime soon. We can also note that current artificial intelligence systems have a marked inability to learn as humans do, i.e., to build causal models of the world on the basis of as little information as humans typically use for that purpose (Lake, Ullman, Tenenbaum, and Gershman, 2017). That does not bode well for the sexbot project.

Davis's comment raises the further issue of what some call "Moravec's paradox." It is named after Hans Moravec who gave expression to it in his 1988 book *Mind Children* (pp. 15–16). It turns on the twin claims that high-level reasoning such as humans engage in requires relatively little computational power to model artificially, but low-level sensory-motor skills require very large computational power and largely escape our current capacity to model in artificial devices. This is why the average human toddler has physical intuition and skills that vastly exceed the capacities of any existing robots today. This is why it took so long to develop robots able to walk well, to run, to climb stairs without falling over, and so on. As Steven Pinker has put it: "The hard is easy, and the easy is hard" (2007, pp. 190–191). And this brings us to a short series of other practical problems for the development of actual sexbots.

As defined, real sexbots require a combination of high-level artificial intelligence, physical agility, physical mobility, and an adequate power system to maintain all of that for periods of time suitable for engaging in real sex with real humans. The power problem is mentioned only once in *Robot Sex* (p. 157) and then only in terms of the option for rechargeable batteries (there are several other ways of powering robots, though many are not usable in humanoid robots due to their size). If we look among currently available robots, the most agile and mobile of them all seems to be Honda's Asimo, which also has a battery life of about 90 minutes per charge. And you can buy Asimo today. But it will cost you $2.5 million; you can lease an Asimo for $1.8 million per year (all prices are taken from the manufacturers' websites or other online sources). Other robots similarly mobile or agile cost less: the PR2 can run two hours on a charge and costs a mere $400,000; NAO-Evolution has no artificial intelligence, runs for 90 minutes on a charge and costs $280,000. The advanced social robot iCub costs $270,000; and the Korean robot HUBO-2 runs $400,000. The issue of expense can be intensified. For if Asimo is anything to go by, a real sexbot is likely in its first generation at least, to cost significantly more than $3,000,000 (to allow for R&D costs of that artificial intelligence development as well as other modifications of the robot body for sexual use: the PR2, for example, as currently configured can only bend at its waist about ten degrees). Even if the customary decline in costs of one order of magnitude every ten years applies to this technology, sexbots are still going to be very, very expensive. The issue of cost is raised a number of times in *Robot Sex* (pp. 40, 237, 263, and 298), but does not place any definite numbers on that expense. If the authors did, one would realize very quickly that virtually no one outside of the very richest layer of human cultures is going to buy real sexbots, even if they do become available. Purchase of sexual gratification by commercial sex workers would be vastly more cost effective (but would entail no new ethical problems). Indeed, virtually anyone would be better off using his or her money in some way other than to purchase (or lease) a sexbot. And there is yet another, deeper, issue that blocks the judgment that sexbot technology is imminent. It has to do with the emergence of a new paradigm for understanding artificial intelligence systems in relationship to humans.

Lying behind much of *Robot Sex* is a view of robots as tools for the fulfillment of human desires. As such, sexbots are also seen as substitutes for and competitors with their human counterparts. This is a common view, especially when it comes to consideration of how robotic technologies (like computers before them) are liable to usurp human jobs, status, and influence. Here they replace humans as sexual partners, and potential replacements are actual competitors. But many in the artificial intelligence community are now implementing a different paradigm. It derives from the thinking of Liklider (1960), and sometimes goes by the name of "human–artificial intelligence symbiosis." In this view, humans and artificial intelligence systems (whether robotic or otherwise embodied) are joined together as functional units, each contributing to the common task what they are best at: artificial intelligence systems handling large amounts of data, for example, while humans engage in creative thinking and strategizing. One illustration is from the world of high-level chess competitions. Gary Kasparov, world champion, was soundly beaten in a competition with the artificial intelligence system Deep Blue in 1997. He thought long and hard about what that experience taught him, and decided to run a different kind of chess tournament. In it humans were allowed to team up with other humans and any combination of computer systems they wished to use. The amazing thing is that the tournament, replete with grandmasters and advanced deep learning AI systems, was won by a team of two amateur chess players and their three laptop computers. The humans did what they were good at, the computers did what they were good at, and the process of cooperation initiated and supervised by the humans was relatively free of friction. The result was a decisive win for Steven Cramton, Zackary Stephen and their computers (Cowan, 2013, pp. 77–93; Kasparov, 2017). The whole subject of such symbiotic relationships has exploded in recent years, deeply enriched by the addition of the notion of social "niche" drawn from ethology and ecology (Farooq and Grudin, 2016; Miklosi, Korondi, Matellan, and Gasci, 2017). This should be of great interest to sexbot researchers, for sexuality is easily recognized as a social niche phenomenon (Flynn, Laland, Kendal, and Kendal, 2013). But this new way of thinking about artificial intelligence invites a whole different way of thinking about both robotic and human sex, as well. In particular, it requires understanding sex as an emergent phenomenon of cooperative dyads (or other social configurations). But it also makes it possible that real sexbots will not need general human level artificial intelligence, but could get by with something less powerful. This should be attractive to the authors of *Robot Sex*, as lightening their evidential burdens.

Are sexbots, then, and as defined, possible? Not in terms of current robotic technology, nor any time soon, according to experts. And, if the problem of expense is not sharply ameliorated, sexbots are also unlikely to emerge in anything like the fashion imagined by *Robot Sex*: i.e., as a technology so pervasive in human cultures as to raise serious ethical challenges and herald significant social changes. Which brings me to the next issue: How did this group of writers get so misdirected in thinking about sexbots? Here we need to return to some of the evidence they do consider, but that hovers tantalizingly on the periphery of their discussions.

The Imagination Trap

Popular films have been full of highly sophisticated artificial intelligence systems and social robots for a long time: think of the lovable droids C3PO and R2D2 in the Star Wars films (*Robot Sex*, p. 94); the terrifying "terminators" in that series of films; the female chatbot Samantha in *Her* (Ellison, Jonze, and Landay, 2013, mentioned on pp. 9, 94, 155); the shrewd and seductive Kyoko and Ava in *Ex Machina* (Macdonald, Reich, and Garland, 2014), or the equally seductive David in *AI: Artificial Intelligence* (Curtis, Kennedy, and Spielberg, 2001, mentioned at *Robot Sex*, pp. 94, 155). Even the replicants of *Blade Runner* (De Lauzirika, Deeley, and Scott, 1982) come into the same picture, and, though these are fully organic, they answer well enough to Danaher's "artificial entity" in his first definition of "sexbot." Behind much of these developments lies the earlier science fiction writing on robots by Isaac Asimov (who is mentioned on pp. 4 and 276). In all these treatments we are invited (perhaps even compelled) to regard the "artificial entities" as full moral agents and persons in their own rights. Certainly they are possessed of general human level artificial intelligence. Indeed, they may appear simply to be such systems as with Skynet in the Terminator films, the infamous HAL 9000 in *2001: A Space Odyssey* (Kubrick, 1968) or VIKI in *I, Robot* (Davis, Dow, Godfrey, Mark, and Proyas, 2004). In all these cases we readily attribute mental states to them: they have beliefs, goals, purposes, projects, high-level cognition, sophisticated sensory experience, subjectivity, memory, and so on. Such attribution is known as taking the intentional stance (Dennett, 1983, 1987). We adopt that stance precisely in order to understand and predict the behavior of other agents, and perhaps also to control them (Levillain and Zibetti, 2017; Zawieska, Duffy, and Spronska, 2012). Of course, we so readily adopt the intentional stance towards artificial beings in films because they are actually played by real human beings. To understand the grip the intentional stance has on our imaginations, we have to review some of its basic biological features.

The intentional stance has an early ontogeny in humans. A rudimentary form has been found as early as three months of age (Kim, 2015; Luo, 2011; Sommerville, Woodward, and Needham, 2005). It is more securely evident by six months of age (Csibra, 2008; Southgate and Vernetti, 2014) and is very secure by the end of the first year of life (Gergely, Nadasdy, Csibra, and Biro, 1995; Kuhlmeier, Wynn, and Bloom, 2003). Moreover, attribution of intentional states does not require a human agent for its target: boxes and abstract geometrical shapes may serve, provided they appear to be self-animating. Heider and Simmel (1944) found this effect in adults in 1944, and many experimenters have more recently found it in very young children (Csibra, 2008; Luo, 2011; Luo and Baillargeon, 2005). It is not surprising, then, to find full-blown intentionality ascribed to robots, also in early childhood (Kamewari, Kato, Kanda, Ishiguro, and Hiraki, 2005; Moriguchi, Kanakogi, Todo, Okumura, Shinohara, and Itakura, 2016). By the time children reach 4-6 years of age, their intentional stance has reached adult levels of sophistication. And adults are also only too prone to assimilate their experience of robots and virtual agents to that of their fellow humans (Bartneck, Kulic, Croft, and Zoghbi, 2009; Holz, Dragone, and O'Hare, 2009).

Attribution of intentional states to other agents may well have a distinctive neural basis in the functioning of the default mode network, which by two years of age has reached functionality and connectivity similar to that found in adults (Spunt, Meyer, and Lieberman, 2015). Partly for this reason, intentional cognition has close ties to the development of pretend play in young children. Such play emerges in the period of eighteen months to twenty-four months of age (Lillard, Lerner, Hopkins, Dore, Smith, and Palmquist, 2013; Weisberg, 2015), and continues throughout the lifespan (Göncü and Perone, 2005). Both intentional stance and pretend play, in turn, have deep connections to imagination (Haight, Wang, Fung, Williams, and Mintz, 1999; Harris, 2000, pp. 37–54). Indeed, so deep are the ties, both functionally and neurobiologically, between imagination, play, and the intentional stance, that we may reasonably posit that when it comes to imagining non-human agents, the default position for humans is to take the intentional stance (cf. Ma and Lillard, 2017; Weisberg and Gopnik, 2013).

Pretend play and the intentional stance, together with similar underlying default mode network functioning, are all found together also in our close primate relatives (Barks, Parr, and Rilling, 2013; Buttelman, Buttelman, Carpenter, Call, and Tomasello, 2017; Buttelman, Schütte, Carpenter, Call, and Tomasello, 2012; Kupferberg, Glasauer, and Burkart, 2013). Together with the rest of our evidence, we thus see early intentionality, imagination, and play emerging together, in a fixed sequence. Neither is it difficult to assign adaptive value to these early cognitive mechanisms:

> … pretend play might serve to heighten children's sensitivity to social signs. This sensitivity could assist the development of theory of mind, with which social pretend play is associated … to allow for sophisticated coordination of social behavior in later life. (Ma and Lillard, 2017, p. 441)

Accordingly, there is good reason to say that the intentional stance and its connection to imagination is hard-wired to the human species (as *Robot Sex* itself suggests on p. 206, but gives no argument for). It either is itself a primal cognitive mechanism, or it is the result of such a mechanism (as, e.g., a form of probabilistic reasoning: see Weisberg and Gopnik, 2013).

I think this is what has happened to the authors of *Robot Sex*. They have fallen into what I call the imagination trap. Imaginary robots like R2D2, C3PO, Ava, Kyoko, David, and the rest, have seduced them into thinking that sexbots are not only possible, and imminent, but also possessed of all the basic capabilities of human agents. The free play of their imaginations has not been sufficiently checked by empirical evidence drawn from relevant robotics and engineering findings to prevent inception of the default position for human imaginative response to artificial agents. Such a check is essential if we are to avoid even very sophisticated conceptual and argumentative pursuit of a putative technology that turns out to be, on more critical reflection, a mere will-o-the-wisp. But there are also some other failings of this collection to draw attention to.

Robot Sex for Disabled Persons: Ethics and Making Social Scientific Evidence Evident

Ezio Di Nucci's essay (chapter 5) argues that real sexbots could assist in providing sexual satisfaction for disabled persons, who might be unable to find such satisfaction any other way. It is difficult not to agree with Di Nucci that disabled persons have substantial reasonable expectation of assistance in these matters. However, my complaint here is that Di Nucci writes as if there were no other social scientific literature discussing the same issues. But there is, and it is substantial. Some studies argue that personal assistants or commercial (human) sex workers should be made available for such purposes (Mona, 2003; Sanders, 2007). Of course, authorizing commercial sex workers would amount to decriminalizing (at least to some extent) prostitution, and there are serious countervailing considerations (see Fritsch, Heynen, Ross, and van der Meulen, 2016). There is also an ample literature dealing with the global general need to acknowledge and protect the sexuality of the disabled (Addlakha, Price, and Heidari, 2017; Shah, 2017). And of particular interest is a recent study of public policy differences between the treatment of these issues in Denmark (which is relatively permissive) and Sweden (which is not): see Kulick and Rydström, 2015.

Kulick and Rydström's study is particularly valuable because it amounts to analysis of an on-going empirical experiment in competing social policy solutions to the main problems of disabled sexuality and how best to meet them. This is at least in the spirit of John Danaher's call for empirical social experimentation on robotic sex. It is disappointing that Di Nucci writes as if none of this literature existed. But it shows that there are alternative solutions to the problems he raises. Moreover, if I am right about the magnitude of the cost problem for developing and purveying real sexbots, neither disabled persons themselves nor public (or private) agencies supporting them are likely to make use of sexbots. Di Nucci, in this reviewer's opinion, owes his readers exposure to the wider social scientific literature, if only to create a critical framework in which to weigh the merits his own solutions in this essay to the problems posed by disabled persons' sexuality. All this is in apparently sharp contrast to the chapter 13, by Scheutz and Arnold. Or is it?

Connecting Ethics to Evidence

Amazon's Mechanical Turk (AMT) is an online platform for conducting polling. Scheutz and Arnold make use of it in discovering attitudes of 198 respondents to sexbots and their uses. It must be said at once that Mechanical Turk has been shown repeatedly to be a viable tool for social scientific research, across a broad range of issues (Crump, McDonnell, and Gureckis, 2013; Miller, Crowe, Weiss, Maples–Keller, and Lynam, 2017). In particular, Mechanical Turk is reckoned to be at least as good as standard online recruitment or on-campus recruitment of subject pools (Bartneck, Duenses, Moltchanova, and Zawieska, 2015; Kees, Berry, Burton, and Sheehan, 2017). However, others have been careful to note that there is nothing inherent in Mechanical Turk to insure its value: care must also be taken in the design of probing instruments and data analysis (Cheung, Burns, Sinclair, and Sliter, 2017; Rouse, 2015). Care must also be taken to insure that samples are genuinely representative of the populations being investigated, that participants are genuinely attentive and honest in their responses, and to recognize that randomized sampling is not possible (Chandler, Mueller, and Paolacci, 2014; Cheung et al., 2017; Huff and Tingley, 2015; Rouse, 2015). A recent study by the Pew Research Center (Hitlin, 2016) found that users of Mechanical Turk have a marked demographic profile: they tend to be mainly United States-based (80%), mostly white (77%), having some college education or a college degree (87%), to use Mechanical Turk daily or more than once a week (63% and 32% respectively), and most are aged 18–49 years (88%), while genders tend to be evenly split. But this is already a problem for Scheutz and Arnold. They say that they used Mechanical Turk in order to reach a "larger demographic" than was customarily reachable by polling college students. Is this supposed to be the population of the United States at large (which, however, is only about 60% white, and only about 60% have had any college)? We are not told (neither does their earlier 2016 study tell us). Indeed, we are told very little about the 198 subjects of Scheutz and Arnold's experiment reported in *Robot Sex*. Neither are we told much about what steps they took to insure attentiveness and honesty in their respondents, nor how they understand the significance of their data in light of the absence of randomization. It turns out to be of some importance also that the task set for Mechanical Turk respondents needs to be carried out in a uniform environment, or risk losing internal validity (Chandler, Mueller and Paolacci, 2014). On this score, likewise, we have no information from Scheutz and Arnold: How did they control extraneous variables affecting their respondents? In sum, it is not clear that Scheutz and Arnold have exercised due diligence in the design and analysis of their experiment. All this raises serious doubts about how their findings are supposed to tell us anything about a larger population.

More conceptually puzzling is their stated motivation for making the study in the first place: "It can enhance ethical arguments to consider how a number of actual people currently regard the notions being discussed" (p. 248). But nothing is said about just *how* such enhancement is to work. Are we to adjudicate difficult ethical issues by counting heads?

(If so, this smacks of the position in ethical theory known as Normative Relativism, which is deeply problematic.) The reader is left entirely in the dark about how to connect such Mechanical Turk-based research to ethical arguments. And thus, while Scheutz and Arnold show a commendable sensitivity to the importance of empirical data at the close of their essay (p. 258), they have failed in perhaps the single most important of their epistemic duties to their readership: they do not tell us how to use the data they themselves have generated. And so, we are still left just where Danaher said we were at the end of chapter 7: "What we lack is data" (p. 126). Only here "we" has to include the readers of *Robot Sex*.

Further Vicissitudes of Evidence: In the Uncanny Valley

In 1970 the computer scientist Masahiro Mori hypothesized that as robots came more and more to resemble humans, our positive affective and motivational responses to them were likely to rise steadily until that resemblance reached a certain point. Thereupon our affective/motivational response was likely to plunge and we were likely to respond to robots that too closely resembled humans with disgust, fear, anxiety, a sense of their eeriness, and avoidance. Further increases in resemblance, however, were likely to cause our affective and motivational responses to rise in a positive fashion once again. This plunge and recovery was what Mori meant by the "uncanny valley effect." Clearly such an effect would be a problem for real sexbots and human acceptance of them. For, *ex hypothesi*, real sexbots resemble humans in form, secondary sexual characteristics, gender, voice, movements, touch, temperature, behavior, and cognition. Realism about sexual characteristics has been shown to intensify the uncanny valley effect (Carpenter, Davis, Erwin–Stuart, Lee, Bransford, and Vye, 2009; Otterbacher and Talias, 2017). We may also expect that the intimacy of sexual relations with robots would have a similar effect, as intimacy tends to heighten most emotions that it engages. Thus how we relieve the effect is a significant element in any actual instantiation of sexbot technology. This issue is treated especially in Chapter 14 by Julie Carpenter, upon which some previous remarks have been made. Here I want to dwell on her treatment of the uncanny valley effect (*Robot Sex*, pp. 274–283), for it is very puzzling.

The puzzle is that she makes so little use of highly relevant empirical findings from computer science, engineering, and robotics regarding the uncanny valley effect. It is true that she refers to her own 2016 book on military use of robots, and that book, as noted earlier, is replete with encounters with technical literature. But in *Robot Sex* that literature is, at best, at one remove, and at worst is simply ignored. Indeed, while she refers to her own book several times with specific page numbers added (footnotes 24, 38, and 48), she more frequently uses merely the book's title with no specific page references (footnotes 23, 24, 27, 40, 44, and 45). And this introduces a further remove from relevant evidence for readers of *Robot Sex*. Her own discussion of how to alleviate the uncanny valley effect is pertinent, but would benefit enormously by direct encounter with that evidence. Indeed, almost everywhere in that discussion she has readily available a stronger argument, if she would just use the evidence. What does the evidence show?

First, it leaves very little doubt that Mori's hypothesized effect is a real phenomenon (Ho and MacDorman, 2017; Kätisyri, Förger, Mäkäräinen, and Takala, 2015; Mathur and Reichling, 2016). If you can measure a phenomenon, then it is real enough (there is thus no need for Danaher to be as tentative as he is about the uncanny valley effect on p. 10). We also now know something of the biological underpinnings of the uncanny valley effect. It has an early ontogeny, like many basic cognitive mechanisms in humans, emerging between six months and twelve months of age (Ferrey, Burleigh, and Fenske, 2015; Lewkowicz and Ghazanfar, 2012; Matsuda, Okamoto, Ida, Okanoya, and Myowa–Yamakoshi, 2012). We know something of its neural basis, engaging elements of the default mode network, of the limbic system, and especially circuits for scanning eye-regions and mouth-regions of faces, with the eye region especially dominant (Cheetham, Suter, and Jäncke, 2011; Saygin and Frith, 2012; Schindler, Zell, Botsch, and Kissler, 2017). The causes of the uncanny valley effect are not agreed upon (discussions in MacDorman and Chattopadhyay, 2016; Schindler, Zell, Botsch, and Kissler, 2017; Stein and Ohler, 2017). But we also know that the effect is found in some of our close primate relatives (Steckenfinger and Ghazanfar, 2009), which suggests that it might well have been present in our last common ancestor. We've good reason, then, to think that the uncanny valley effect is at least as primal a cognitive mechanism as is the intentional stance, and that it belongs to our ancient equipment for sociability, here governing especially encounters with strangers. That sociability, in turn, has everything to do with our evolutionary success as a species (Henrich, 2016; Sterelny, 2012; Tomasello, 2009). It is thus unlikely to go away at all easily in the face of the emergence (if such should indeed occur) of real sexbots. Carpenter is quite right that the uncanny valley effect is a serious impediment to their acceptance and use.

Recent investigations have also shown how to mitigate the uncanny valley effect, and some of this is highly relevant to parallel suggestions from Carpenter herself. Thus, a capacity in robots for emotional expression decreases our sense of eeriness (Koschate, Potter, Bremner, and Levine, 2016). Realistic language and speech can also relieve the effect (Ciechanowski, Przegalinska, Magnuski, and Gloor, in press; Markowitz, 2017). Simple repeated exposure to robots can ameliorate it (Laue, 2017; Zlotowski, Sumioka, Nishio, Glas, Bartneck, and Ishiguro, 2015). Indeed, repeated exposure to humanoid robots even via science fiction narratives can also rescue us from the uncanny valley effect (Mara and Appel, 2015). Most of this evidence could very valuably be added to Carpenter's discussion of the effect, which would gain authority from demonstrating such empirical support. Her argument that sexbot technology is more likely to emerge under conditions ameliorating the effect would thus also be the more convincing and not merely a tissue of unsupported assertions. Finally, doubts we might have about the possibility of real sexbots (as defined) might be somewhat relieved by rooting her discussion more firmly in relevant empirical evidence. The next issue is not unrelated to this one, for it has to do with another body of evidence that *Robot Sex* fails to exploit, but would benefit from doing so by better serving the needs of its audience.

Developmental Issues

Virtually nothing is said in *Robot Sex* about human psycho-social development, despite its relevance to several of the book's concerns. This may be because sexbots (as defined) are not biological entities and thus do not develop in anything like the way humans do, though the advent of powerful machine learning algorithms may allow eventually for some simulation of human psycho-social development in artificial entities. But this also indicates a challenge to the possibility of real sexbots, for perhaps those algorithms cannot perform the simulations in question: we do not yet know. In any case there are two broad findings in contemporary developmental science that are relevant to *Robot Sex*.

The first has to do with the hyper-sociability of humans, a form of life that is acquired in the process of early development (except in the presence of major psychopathology, such as autistic spectrum disorders or Williams Syndrome). Such hyper-sociability begins very early, arises automatically, is almost certainly hard-wired and belongs to our ancient evolutionary lineage (see Lieberman, 2013; Narvaez, Panksepp, Schore, and Gleason, 2013; Reddy, 2008; Siegel, 2012). This perspective also provides a naturalistic matrix for the rise of the intentional stance, especially in the first two years of life. It also provides the basis of a decisive refutation of the trans-humanist agenda examined by Michael Hauskeller in chapter 11 of *Robot Sex*. That agenda calls for humans to abandon their dependence on one another and to opt for a radical form of autonomy, a degree of autonomy that Hauskeller argues gives a foothold for the social utility of robotic sex. But the trans-humanist objective is clean contrary to human development in its sociability dimension. This, after all, is how we get to be humans in the first place. A hyper-autonomy that rejects all forms of social interdependence is not likely to be possible or desirable for a hyper-social species: our biological heritage is entirely too imperative for that. The developmental perspective thus furnishes Hauskeller with a stronger argument than the one he deploys against the trans-humanist agenda.

Developmental science also provides a biological explanation for the existence in normally developed humans of an elaborate scheme of morality (Alexander, 2017; Bloom, 2013; Boehm, 2012; de Waal, 1996). The biological origins of human morality have their effects, however, largely independently of conscious deliberate reasoning. Much more important are patterns of social interaction internalized by the development infant, and affective communications between infants and their primary caretakers. This poses both a challenge and an opportunity to Joshua Goldstein in his chapter on natural law and its assessment of sexbots. For that moral theory requires that we grasp so-called "basic goods." Goldstein supposes that we do so by rational means, that is by use of deliberate, conscious, step-wise, and symbolically mediated reasoning. The developmental perspective suggests otherwise. Here, then, is an alternative he needs either to refute or to embrace. Embracing it would give him an entirely naturalistic way to account for our knowledge of basic goods and the similarity of those goods across human cultures. The extent to which such goods are satisfied by sexual relationships between human adults and robots is, of course, a much further matter. But his appeal to natural law theories would gain a much wider hearing if it were grounded more thoroughly in a developmental perspective. Theories of natural law otherwise implicate a view of human nature that appeals to only a fairly narrow range of interlocutors (many of them wedded to the traditions of Roman Catholic moral philosophy, as the authorities cited by Goldstein suggest).

This brings me to my final set of substantive objections to the present volume. This focuses on the final essay in the collection.

Making Predictions is Difficult, Especially About the Future

There can be little doubt that the introduction of new technology often results in very significant social change among human cultures: e.g., the introduction of steam power, widespread electrification, introduction of computers, advent of radio, automobiles, television, cell phones, nuclear power. It is not surprising, then, that the putative introduction of sexbots might also conduce to significant social change. It is the purpose of Marina Adshade's final essay (chapter 15) to predict those changes. She hopes to use three historical examples of technology-induced social change to reach a set of four such predictions. My first set of problems has to do with her treatment of those three examples.

The introduction of oral contraceptives in the 1960's is held by Adshade to have driven an increase in the percentage of women engaging in premarital sex, the birth of more children conceived outside of marriage, and wider social acceptance of sex occurring outside of marriage. There is substantial support for Adshade's hypothesis in some recent social scientific studies (Akerloff, Yellen, and Katz, 1996; Bailey, 2006; Goldin and Katz, 2002). But there is also countervailing evidence. The percentage of women in the United States having sex before age 18 has remained more or less constant since 1920 (Turner, Danella, and Rogers, 1995). So also has been the rate of births outside of marriage. Premarital sex proves to be highly normative behavior: almost everyone has sex before marrying and the proportion doing so has remained steady for at least forty years. A slight increase is found for the period 1964–1973, following the introduction of oral contraceptives. But of women born in the United States and in the 1940's, nearly 90% had (premarital) sex by age 44, and 80% of those had refrained from sex during their teen years (Finer, 2007). It is far from clear, then, that oral contraceptives brought about a fundamental difference in these matters. Also, among methods of contraception commonly used by women, sterilization runs oral contraception a close second, or even ahead. Thus one study found that in the United States in 2006–2008, 10.7 million women used oral contraception while 10.3 million used sterilization (Mosher and Jones, 2010; see similar results for 2011–2013 in Daniels, Daugherty, Jones, and Mosher, 2015). Globally, very large percentages of women who were either married or in a durable long-term partnership have made use of sterilization: in 2012, 38% in the lowest income countries, 45% in the 69 poorest nations, and 33% in the highest income countries (Joshi, Khadilkar, and Patel, 2015; cf. White and Potter, 2014). So we also have to ask whether Adshade is talking about the right kind of contraceptive technology.

A quite different explanation has to do with improvements in maternal health (roughly, the rates at which women died in childbirth) starting in the 1930's in the United States. With the advent of broad-scope antibiotics, ready availability of blood supplies for transfusions in hospitals (hemorrhages then being a leading killer of pregnant women), and supportive public policy through the Social Security Act of 1935, all combined to lower radically the rate of pregnancy-related mortality, starting in 1936 and reaching contemporary levels in the 1950's — all well before oral contraception became possible. With the health costs of having children lowered substantially, there was a corresponding rise in the economic returns expected from female education, and this in turn sponsored an enormous rise in the number of women receiving education at high-school and college levels (Albanesi and Olivetti, 2014; Jones and Tertilt, 2007). So, here is a powerful alternative explanation for many of the social changes that Adshade puts down to the advent of effective and inexpensive oral contraceptives. She owes her readers a more nuanced treatment of this matter. And it is far from clear that any of this has anything to do with the putative coming of sexbots and their impact on social change.

Adshade also believes that just as the coming of the Internet, and especially of widely available and free pornography on the Internet, has lowered rape rates in the United States, so also will the coming of sexbots have a similar effect, and thus constitute a significant social good. There are three problems with this view. The first is that what she posits is simply a correlation, and a causal relationship is not implicit in such a correlation. Second, the evidence regarding steady consumption of pornography causing aggressive sexual behavior by males is so mixed as to leave that causal connection moot in the opinion of some recent investigators (Fisher, Kohut, Di Gioacchino, and Federoff, 2013; Levy, 2002). It is notable that Zillman and Bryant's study of the effects of pornography on sexual aggression in 1984 (well before the Internet as we know it, which began in 1990) is startlingly similar to the conclusion drawn in 2016 by the American College of Pediatricians (see American College of Pediatricians, 2016; Zillman and Bryant, 1984, 1988). It is thus far from clear that the Internet has had the result Adshade asserts. Perhaps more challenging still is the issue of whether rape rates in the United States have, indeed, fallen as Adshade avers. She hints at the issue of under-reporting (p. 291) but does not follow it up. A recent important review shows that many large-city police forces systematically under-count the incidence of rapes in their jurisdictions (Yung, 2013). This study should be confronted and either overturned or taken into account by Adshade. The effect she is seeking is not supported by this evidence.

Adshade's third historical example asserts a causal relationship between increased ownership of household appliances and reductions in hours spent in onerous household chores by women. However, while some studies find substantial declines in time/energy spent in household management tasks (Archer, Shook, Thomas, Church, Katzmerzyk, Hebert et al., 2013; Bryant, 1996; Greenwood, Seshadri, and Yorukoglu, 2005), other studies found little or no change (Cowan, 1985). Yet others found that time/energy spent in household management actually increased about two hours per week in the period 1900–2005 (Ramey, 2009; cf. Vanek, 1973). Yet another study (in the United Kingdom) draws this very clear conclusion: "…domestic technology rarely reduces women's unpaid working time and even, paradoxically, produces some increases in domestic labour" (Bittman, Rice, and Wajcman, 2004). It is not clear, then, that household appliances actually had the time/energy effects asserted by Adshade. We need an argument that overturns or assimilates the countervailing evidence.

There are other factors at work, also, in this case. Massive increases in women in paid employment in the twentieth century brought demands for home appliances, but it also brought a significant increase in household wealth. And some of that wealth got spent by outsourcing household chores, notably food preparation and childcare. For example, Archer and colleagues (2013) found that in the United States in 2000 as much as 50% of all household food costs were devoted to eating out (cf. van der Lippe, Tijdens, and de Ruijter, 2004, on similar Dutch experience). The structure of household management also changed, with males taking up a much larger amount of time/energy spent on those tasks (Aguiar and Hurst, 2007; Ramey, 2009). Enhanced female education also plays a role here: the fraction of women having a primary education or less fell in the United States from 0.95 in 1900 to 0.17 in 1980 (Ramey, 2009, p. 21, Table 5B). With increased education goes enhanced participation in the labor force, rising expectations of social mobility, and economic capacities to outsource many household management tasks (Cortes, and Tessada, 2011; Cunningham, 2008; Hazan and Zoabi, 2013). Members of extended family networks (e.g., elderly persons living in the same household) also made increasing contributions to household management (LaFane and Thomas, 2017; Witoclar, 2013). There is no obvious or unique causal tie between increased ownership of household appliances and reductions in time or energy spent in household management by women. It follows that this example has little or no bearing on technologically induced social change, as Adshade requires it to do. By failing to take into account the full range of social scientific evidence relevant to her historical example, she does her readers an epistemic disservice: they are not being critically connected to the relevant empirical evidence. There are also more general problems with some of Adshade's predictions regarding technologically induced social change for sexbots.

Adshade avers that "Sexbot-induced social change (SISC) is on the horizon" (p. 289). And she wishes to use her three examples as "a tool for understanding the process through which social norms evolve in response to the availability of new technologies" (p. 290). But, it is far from clear just what kind of predictive tool they afford. A little later she refers to them as giving us "the courage to think about" such changes (p. 292). That is a curious expression. It suggests that she herself knows she is about to take a leap into the dark. Nevertheless, we are faced with four predictions. The fourth one is that "Changes in social norms around marriage and sexual access will disadvantage those in the lower socioeconomic groups" (p. 297). With this I am in agreement. Indeed, I have given reason earlier in this essay for thinking that real sexbot technology will be vastly beyond the reach of anyone other than the very rich; Adshade does not go nearly far enough to capture this point. Her three other predictions are more problematic.

The first is: "The adoption of Sexbot technology will disentangle the association between sexual intimacy and marriage, leading to higher quality marriages" (p. 292).

Marriage is an institution, and as such is constituted by and called into existence by virtue of its constitutive rules (Searle, 2005). It has also proved, in the modern period, a remarkably resilient institution. If sexbot technology is only a playground for the very rich, it is unlikely to influence so resilient an institution as marriage in its fundamental constitutive rules. Only much more widespread social movements are likely to do that. Moreover, some recent sociological investigations suggest that the tradition of romantic love that stretches back in Western culture to the medieval period (Luhmann, 1986; Reddy, 2012; Schultz, 2006) continues to structure our society's understanding of marriage, notably by way of "long-term internally structured marriage" (Gross, 2005; Gross and Simmons, 2002). Gross's main point is that this view of marriage, while its regulative force has declined, has retained its power to give meaning to marital relationships. This view of the semiotic resilience of marriage in the face of contemporary developments (same sex marriages, civil unions, legalization of cohabitation, and the like) is a problem for the first half of Adshade's prediction. The other half depends on applying to marital decision-making Le Chatelier's principle in order to secure the promised improvement of marriage (p. 295). However, Le Chatelier's principle requires a system that is closed and that operates homeostatically (using feedback mechanisms to maintain an average value between fixed outer parameters). But, decision-making is not a closed system in human beings, and does not operate homeostatically. Rather, it allows for the influence of external forces, and it allows that any homeostatic functioning operates within parameters ("set points") that can themselves be changed or moved. Systems like these also typically possess feed-forward systems to enable predictive functioning; and they are known as "allostatic" systems (Schulkin, 2004, remains the standard treatment of these issues). Perhaps the clearest evidence for the allostatic status of human decision making lies in the role played in it of stress (Gu and FitzGerald, 2014; Hermans, Henckens, Joëls, and Fernandez, 2017; Starcke and Brand, 2012). There is thus no good reason to expect marital decisions to adhere to Le Chatelier's principle. But without such adherence, according to Adshade's reasoning, changes in marriage, if they were to occur, are not guaranteed to leave the institution no worse off than it was originally. But, frankly, there is not much reason for thinking that what Gross calls the long-term internally structured marriage paradigm has yet undergone fundamental change, nor that sexbot technology, were it to become real, would change it either.

Adshade's second and third predictions belong together: "The adoption of sexbot technology will lead to the normalization of nonexclusive relationships as the dominant relationship structure" (p. 295), and: "Legal marriage institutions will be reformed to allow individuals to determine the nature of their own marriages free from state interference" (p. 297). Both claims are clearly deeply connected to each other. And both fail to persuade for the same set of reasons. Modern states regulate the institution of marriage (whether heterosexual, homosexual, or in the form of civil unions or cohabitation) for a wide variety of reasons, including, but not limited to the following: to secure property rights and the regularity of inheritance patterns; for the protection of individuals against abuse (especially children and elders); to help manage disputes; to structure and enforce household taxation; to regulate medical decisions, adoption rights and their enforcement; access to publicly funded social benefits; and household members' exposure to civil obligations such as jury duty or mandatory military service. It is thus very unlikely that any state will ever allow individuals to make of marriage what they will regardless of the state's interests. For, none of those needs or requirements is going away any time soon, least of all under the impact of sexbot technology. Many of the regulative interests of the state also require that marital relationships or cohabitation involve exclusive relationships. It's a nice fantasy to think about marriage becoming an institution free of all state interference, but a fantasy nonetheless.

To some extent we also have some experimental evidence in this matter. For one thing, marriage continues to play an important role as a solution to female poverty, and even single women often live "in the shadow of marriage," e.g., when it comes to the legally enforceable rights of their children (see Dubler, 2003). Marriage continues to pay a substantial benefit in the form of "enforceable trust" and as "a marker of prestige" (Cherlin, 2004; and for prestige as a social good see Milinski, 2016). The long-term internally structured marriage noted by Gross has also proved flexible enough to largely structure institutionalization of same-sex marriages (as Chambers, 1996 predicted). There is also evidence that cohabitation is being regularized in terms of marriage rather than the other way round (Berrington, Perelli–Harris, and Trevena, 2015; Lundberg, Pollak, and Stearns, 2016). Rather than seeing marriage "deinstitutionalized" in the contemporary world, even given new forms of marriage, state regulation of cohabitation, and other changes, we have seen instead the resilience of an institution that would be recognizable to its medieval progenitors, a "re-institutionalization" of marriage (Lauer and Yodanis, 2010). If anything, it is sexbot relationships that are likely to be structured "in the shadow of marriage" rather than the other way round. But there is an even more fundamental problem with Adshade's essay.

It is comparatively straight-forward to measure technological progress along a variety of fronts, and on that basis to predict further progress of the same kind. Thus we can predict increases in computational power, and both Moore's law and Wright's law have been used for that purpose quite effectively (Nagy, Farmer, Bui, and Trancik, 2013; Nagy, Farmer, Trancik, and Gonzales, 2011). Progress in industrial applications of robots can be measured (and forecasted) using information about declining unit costs and increases in the average stock of robots employed per million hours worked (Graetz and Michaels, 2015). This is all well-understood and well-validated use of standard statistical sampling methods. But, either measuring or predicting *social* change as a result of the introduction or spread of a new technology is a much more difficult task.

Indeed, attempts in the 1970's and 1980's to predict the social impacts of advancing use of computers in business and corporate life, for example, regularly went astray. One review of such studies concluded: "Virtually none of the studies mounted so far have been capable of yielding a persuasive and comprehensive view of computer-induced social change" (Attewell and Rule, 1984, p. 1185). The problem is that it is very difficult to know in advance which causal variables to examine (Caporael and Thorngate, 1984). The potential in most situations for any one causal factor to confound measurement of other equally applicable ones is considerable, especially when those variables are independent.

In a truly astonishing study Magee and Devezas (2011) consider two other historical examples of such predictions. The examples make use of two ample data sets that fit mathematical models with remarkable closeness, and both of which have obvious implications for the future direction of social change relevant to the technologies involved. And yet, both sets of predictions turn out to be entirely false. Adshade is attempting to forecast social changes consequent upon introduction of a technology that no one has yet seen, that no one has actually interacted with, and which has been actually in common use nowhere. There is no good reason whatsoever to expect such predictions to be accurate, and many reasons to expect them to be false. As I have tried to show, also, we have some empirical evidence suggesting that three of her four predictions are likely to be wrong. Here we have a new role for the "data" that Danaher so poignantly calls for in *Robot Sex*: confounding the best efforts to predict the likely social consequences of sexbot technology.

Conclusion

Robot Sex is an interesting book that introduces a wide range of ethical issues and problems that might arise in connection with sexbot technology. The essays are, for the most part, clearly written and often vigorously argued. There are analyses of other people's arguments that are done well: e.g., Danaher's analysis of the symbolic-consequences argument in chapter 7; Danaher, Earp, and Sandberg's analysis of the main argument behind the campaign against sex robots in chapter 4. These are well worth reading and taking seriously. The book is also well laid out, physically, and has a good design that is reader-friendly. There is a decent index. The type-face is also a pleasing one and easy on the eyes. However, in addition to the more substantive flaws dealt with in this essay, there are a host of minor editing failures scattered throughout the volume.

At p. 17, paragraph two, line four we get "One the one hand," instead of "on the one hand." On p. 222, paragraph three, line three "withinromantic" needs a space. On p. 297, paragraph four, line seven, the word "be" should be omitted. On p. 263, paragraph two, line six, with "that" or "which" is missing. On p. 285, footnote 24 has a spurious paren. On p. 290, paragraph five, line two, "in" or "of" is missing. On p. 296, paragraph three, line one, "in" is missing. On p. 248, at the end of the third paragraph the reference to "McCurry, 2015" should be footnote eight, which is missing. On p. 150, footnote 50 should refer us to "Itzin," not to "ibid" (otherwise the cross-reference fails). References to classical Greek and Latin texts are often given badly. One does not refer to Plato's *Complete Works* (as in footnote 35 on p. 241) in order to document a specific passage from one particular dialogue (in this case the *Symposium*). Platonic texts are also routinely referred to by using the Stephanus pagination (from the 1578 Geneva edition). Footnote 37 on that same page refers us to a volume of three of Cicero's essays, when the specific passage in mind is taken from just one of those essays (*On Friendship*, chapter 6). Other errors have more to do with matters of fact. Thus, chapter 6 refers us, at p. 100, footnote 3, to the "serving girls" created by Hephaistos and found in Homer's *Illiad*, book 18. These are taken to be robots, but there is absolutely nothing in the text of Homer to suggest that. The girls merely "appear to be golden." Karel Capek (1890–1938) did not invent the use of "robot" for mechanical slaves or servants: he got the term from his brother, Josef Capek (1887–1945). These mistakes are irritating to knowledgeable readers and detract from the other strengths of the book. They also give evidence of editorial sloppiness, whether on the part of the contributors to *Robot Sex* or the staff at the MIT Press (or both).

The more systemic problems raised in this comment, however, are much more serious. When John Danaher cries "What we lack is data," he is not exactly correct: data are available (as I hope to have shown), but the contributors frequently make little or no effort to get the data into play. Data are thus not made available to their readers. More particularly, data are not introduced to the readers in a critical fashion. This is a failure to satisfy one of the primary epistemic duties incumbent upon contributors to a volume like *Robot Sex*. It leaves their readers unable to properly evaluate the contributions of that volume to our ongoing reflection on new technology. There is a better way to go; but, unfortunately, that better way also probably means admitting the non-viability of the basic project.

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