Robots, Love, and Sex: The Ethics of Building a Love Machine

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Abstract—This paper will explore the ethical impacts of the use of affective computing by engineers and roboticists who program their machines to mimic and manipulate human emotions in order to evoke loving or amorous reactions from their human users. We will see that it does seem plausible that some people might buy a love machine if it were created, but it is argued here that principles from machine ethics have a role to play in the design of these machines. This is best achieved by applying what is known about the philosophy of love, the ethics of loving relationships, and the philosophical value of the erotic in the early design stage of building robust artificial companions. The paper concludes by proposing certain ethical limits on the manipulation of human psychology when it comes to building sex robots and in the simulation of love in such machines. In addition, the paper argues that the attainment of erotic wisdom is an ethically sound goal and that it provides more to loving relationships than only satisfying physical desire. This fact may limit the possibility of creating a machine that can fulfill all that one should want out of erotic love unless a machine can be built that would help its user attain this kind of love.

Index Terms—Affective computing, artificial companions, artificial emotions, robotics

1 Introduction

When your robotic lover tells you that it loves you, should you believe it? The roboticist David Levy has provocatively argued that there is nothing about human love and sex that could not be engineered into a suitably designed robot in the relatively near future [1]. He also argues that these machines would not only be psychologically pleasing, but that their users might even eventually find them preferable to human suitors and that the machine itself would feel a love that may have artificial origins but that is nonetheless genuine feelings of love toward its user [1].

The dream of a perfect artificial lover is at least as old as the myth of Pygmalion. It is also a staple of classic science fiction, which abounds in morality plays about the emotional costs of falling in love with one's own creation.

While the prospect of a robot lover is the stuff of science fiction dreams, the design of robots with the ability to navigate human social settings, such as care giving, domestic work, and companionship, does continue to evolve. It is very important in this discussion to disentangle the robots of fiction from the actual robots we are likely to see in the near future. This topic is also difficult due to the overhyped claims of the roboticists who are attempting to build robot and android lovers as well as the hyperbolic media coverage that surrounds their every claim of success. The instant one hears the words "robot lover," many fanciful visions will flood the imagination of all but the most prosaic reader. It is also very possible that those that are in the business of creating robot companions are deeply influenced by the literature and movies that so compellingly depict the fantastic world of robot love. But in this paper, I will attempt to err on the side of conservatism in my prognostication of near future robotics.

We are nowhere near the point where we can build the kind of machines seen in science fiction where androids that are so like humans it is impossible to tell them apart coexist with humans with either utopian or dystopian results. Yet I would like to remind the reader that it does not take much sophistication to build machines that will, at least for a time, engage their user in compelling and affective relations. A good example is the Tamagotchi fad that had people devoting many hours of their lives to the care and feeding of an artificial pet. Another good example is the way a gearhead may fall in love with their car. Obviously, it is not necessarily a need to have robots that can convince the strongest skeptics of their agency, consciousness, free will, and/or intelligence before they will be able to draw on strong loving emotions from their less philosophically demanding users. As we will see in the sections that follow, it might only take a silicone love doll with modest mechatronics to enamor some users. By this I mean that it is possible to create machines that provide stimuli that can evoke strong sexual reactions from some users and that this achievement is far simpler than trying to create a machine that can simulate more complex affective emotions. Because of this, the ethics of robot love is far more pressing than one might think and we do not have to wait for complex android lovers to become commonplace before we begin to address the implications of both the existent technologies and those that are on the horizon.[1]

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1. Readers interested in exploring the many issues involved in the ethical design of artificial companions which go beyond the narrow scope of this paper should start by looking at: Wilks and Yorick (eds.), *Close Engagements with Artificial Companions: Key Social, Psychological, Ethical and Design Issues*, John Benjamins Publishing Company: Amsterdam, NLD, 2010.

In order for an advanced robot be successful in the role of a companion, friend, or surrogate lover, these future systems will need to elicit and manage both the strong human emotions that can accompany the social milieus these machines are designed to be deployed in. In addition, they must appropriately manage the more subtle and continuously changing affective mood of the people that come into contact with the machine on a daily basis.

The psychologist Roddy Cowie argues that most human-computer interaction of the last few decades has been accomplished by the user entering an unemotional state that facilitated interacting with computers but that artificial companions will not be able to be built this way since the:

> Companion's goals are likely to be bound up with emotion—as much to do with making somebody feel happy and confident, as with accomplishing practical tasks economically [2].

The users of these companions will not be able to maintain an unemotional interaction with the artificial companion and instead the machine must be designed to properly navigate what Cowie calls "pervasive emotions," which is also sometimes called "affect," but whatever we call it we also have to admit that we do not completely understand it [2]. For Cowie, pervasive emotions are the positive and negative emotions we get as we determine what things or persons to care about in a given situation, our feeling of attraction and revulsion, our sense of understanding of what is going on in relations between other agents, and our engagement and attention to shared goals [2]. This all serves as a kind of rich information channel between agents that facilitates easy exchanges and emotional understanding. Simply put, it is a kind of comfort with the surroundings and other agents one may be engaged with.

Following Cowie's line of reasoning, then an artificial companion has a complex problem to solve. The machine must be able to detect the signals of its users related to emotions, synthesize emotional reactions and signals of its own, and be able to plan and carry out emotional reasoning [2].

At this time affective computing techniques are only just beginning to touch on the first two requirements of recognizing and synthesizing emotional cues and responses but are still largely incapable of emotional reasoning. We will need all three of these functioning at a very high level to achieve robotic lovers of real worth.

One growing trend in robotics meant to deal with the issues raised by the pervasive emotion problem has been to design hardware and software that utilizes the human psychological tendency to anthropomorphize objects, which can also cause the user to ascribe effective motivations to these robots [3], [4], [5]. Using these affective (or sociable) computing techniques to mimic human emotions helps the systems manipulate human reactions in such a way as to cause the user to interact more easily and fondly with the machine.

Because of these developments in affective robotics, it is argued in this chapter that these designers should recognize certain limits as to how much manipulation of these human psychological tendencies among the prospective users of these machines is ethically permissible. While it can be argued that it is ethically permissible to design robots that act in concord with their users and that this concord will require affective computing applications built into these machines [6], [7], [8], [9], given that we will be able to mimic emotions in a robot long before we will be able to produce truly affective machines, it is advisable to be circumspect in how we exploit human psychology in the design and deployment of these machines [2].

Love is perhaps the most important of human emotions and those who experience it are strongly motivated to attain both the heights and depths of human achievement. Because this emotion is so important and complex it is an ambitious undertaking when roboticists attempt to instantiate this emotion through affective computing techniques. Since manipulating strong emotions is an ethically fraught undertaking, we should be cautious and skeptical when approaching this kind of work. In the next sections, we will look at the complexities of determining what the folk concept of love is, as well as how it is described in cognitive psychology. While many roboticists are well aware of both of these ways of looking at love, they rarely look at the extensive literature within the philosophy and ethics of sex and love, so we will also add that to our discussion. We will also look at how roboticists implement affective love in their machines in the quest to create robotic lovers and conclude with a critique of those efforts as well as offering some suggestions for an ethics of implementing affective love in robotic devices.

In short, this paper will argue for the following claims:

1. Psychological factors in love, sex, and attraction can be at least functionally duplicated in robotics technology.
2. Designers of affective robots can utilize the human psychological tendency to anthropomorphize animals, objects, and technologies.
3. They can also tap into the human predisposition to be interested in developing caring relationships for creatures outside our own species which has evolved in the human species.
4. We will find that psychologists have shown that we are easily duped into believing the feigned affectations of a false lover. If someone acts as if they love us, even if those actions are very minimal and easily contradicted, we will still tend to believe they truly do love us.
5. We will also see that the early adaptors of affective computation and robotics have already begun to prefer human computer interaction to interaction with fellow humans.

Once we have argued for the above we will have to conclude that a robot that can manipulate the described social and psychological tendencies would be able to form relationships at least as real and moving as those we have with our beloved pets and insincere lovers. Robotic love will work, but only because we are so bad at finding a more true love. This will allow us to then look at a beginning proposal for certain ethical constraints that ought to be used to mitigate the damage that might be caused by affective robots that are programmed to manipulate human psychology to simulate a loving relationship. Finally, philosophers have a long tenure in the business of wondering about the

nature of true love. We will conclude with a discussion on what the philosophy of love and sex can usefully add to affective robotics. We can design machines some of us will fall in love with. The more interesting question is, can we design machines that could make us and our machine lovers better for having fallen in love?

2 Robotic Lovers

2.1 Seriously, What Is Love Anyway?

There is a great deal of ironic humor to be found in imagining highly educated researchers puzzling over how best to create a robotic love and sex when actual love and sex is everywhere around us. Even as I write this sentence two doves are courting one another on a tree branch outside my window while undergraduates walk by on the path below, trysting and holding hands. Finding love seems as easy as just going outside and looking in any direction.

But Levy [1] reminds us in his groundbreaking book *Love and Sex with Robots* that there are some compelling reasons that might cause people to legitimately want to have robotic lovers. There are tragic reasons, such as physical or emotional deficiencies that make finding a human partner impossible, which might be alleviated by robotically assisted sexual therapy. Or perhaps one is not interested in, or does not have the time to develop, a full loving relationship but just wants a sexual encounter, yet one also finds institutions like prostitution objectionable; a robotic prostitute might then be a palatable solution. This option might also end the ethically troubling human sex industry by replacing objectified human beings with actual objects that presumably have no rights to worry about.

It is also possible that these machines might be used to enhance human sexual relationships as a kind of super love toy. But Levy's most interesting argument from a philosophical point of view is that we should take this technology seriously mainly because we might be able to experience a more perfect love through its use.

A machine that was designed to be the perfect match for its user and was also programed to love the user completely would be immensely pleasing. Levy argues that this kind of machine would also be a close friend that will certainly "...behave in ways that one finds empathetic, always being loyal and having a combination of social, emotional, and intellectual skills that far exceeds the characteristics likely to be found in a human friend" [1, p. 107].

Who could pass up a chance to be with their robotic soul mate? The robot would be interested in all the same things as its user. It would be built to the user's specifications so that he or she found it to be physically sexually attractive. Best of all, the robot could be programmed to be always loyal to its user and display fascination toward him or her and whatever they have to say. This would be a dream come true. Levy's argument is that since these robots could add so much love and happiness to our world, it is almost a moral imperative that we work to make these theoretical robotic companions a reality.

The logic is simple, robotic companions would give us perfect love; perfect love is a moral good, so robotic companions would provide us with a moral good. But the argument is also begging a number of questions. Are robots really capable of achieving all the qualities necessary for a perfect lover? And even if they are, is the brief list of qualities just outlined above sufficient for all we want out of a loving relationship?

2.2 Robot Sex

Before we address these questions we should cede one important point to the roboticists working in the area of artificial companions. It is obvious that they will be able to build successful sex robots that some people will find very compelling and will readily use. Different haptic devices are already in production that interface with the genitals of male users.[2] The machine links to adult films. The device simulates the actions on the screen for the person watching the film through small lubricated conveyor belts, heating elements, and bellows. This device is not exactly what one thinks about when they imagine a robot, but it is where this industry seems to be starting. There is also already a brisk business in life-sized, realistic silicone rubber love dolls such as the infamous "Real Doll."[3] Obviously, people are willing to pay a premium price for these dolls even though *Real Dolls* have no capability to interact dynamically with their user.

Recently, there have been at least two companies to enter this market who have released both male and female sex dolls to which they have added meager amount of physical interactivity through modest mechatronics and simple android technologies. Their machines can autonomously bump and grind in a somewhat awkward fashion, while their artificial heart beats rapidly under their heaving silicone breasts as they encourage their human lovers with an X-rated AI chatbot controlled voice; all no doubt to the great delight of their owners [10], [11].

Levy [1] devotes four chapters of his book to a well-crafted and meticulous argument describing the human psychology of sex and how roboticists will be able to successfully exploit our prurient interests and how that may actually help mitigate certain sexual and marital pathologies and dysfunctions.

The situation may be even more complicated as psychologists Meston and Buss have catalogued over 237 different reasons that people express for having sex [12]. Many of the reasons are what one would expect: "I wanted to experience physical pleasure," "I wanted a child," or "I desired intimacy," but some are unexpected, such as "I wanted to punish myself" or "I wanted to get closer to God." Meston and Buss broadly categorize the responses into four main reasons: physical (attraction or pleasure seeking), goal attainment (to get a job or raise), emotional (it was romantic), and insecurity (it was my duty or obligation) [12]. Meston and Buss also found that while men and women reported many of the same reasons for having sex, the top reasons for having sex were ordered slightly differently depending on gender. For instance, the number one reason for both men and women was "I was attracted to the person," but "I wanted to express love for

2. For example, see: http://www.realtouch.com/static/0004/index.html.

3. http://www.realdoll.com/.

the person" was reason number five for men and eight for women [12]. While surveys like these are not perfect methods of study for the complex psychological questions surrounding human sexuality, they do cast some light on the situation and suggest that human sexual motivation beyond the purely physical is a very complex affair and may not be something that can be fully captured by robotics. Still, there has been some success with machines that appeal mainly to the physical sexual motivations of their users and it is likely that appealing to these motives will lead to the greatest short term success in the design of love machines.

Since the technologies needed to make interactive sex dolls already exists and real humans are actually choosing to have sex with these dolls, then it is likely that Levy is correct at least in his prediction that an increasing trend toward sex with robots is just beginning and that it is likely to continue to gain popularity, leading to a very strange and wild future.

2.2.1 Love Prototypes

The folk definition of love is a very loosely defined concept. It is a cluster concept that is associated with other concepts such as: care, attraction, affection, and liking.

Fehr and Russel [18], [19] conducted a survey of the types of love people refer to. They received 93 different "types" which they then asked respondents to rank in order of their closeness to ideal love.

Here, are some of the responses in descending order of closeness to the prototypical concept of true love:

Love Prototype

1. maternal love,
2. parental love,
3. friendship,
4. sisterly love,
5. brotherly love,
6. romantic love,
7. passionate love,
8. sexual love,
9. platonic love.

One counterintuitive thing that comes from this analysis is that passionate and sexual love are lower on the list than parental love and friendship, with motherly love being the most closely related type of love to what we mean by the abstract word "love." It is correct to ask where on this list should we seek to place the new prototype, robotic love. It does not look like the kind of relationship one has with a sex robot even makes it onto this list, even though it might have some superficial similarities with sexual love.

One way to counter this claim would be to suggest that the concept of prototype is not an evaluative claim; it is not saying that motherly love is somehow "better" than sexual love. That is true, of course, and failure to develop an understanding of the difference between motherly and sexual love would lead one to a Norman Bates-like existence. That is not the point I am trying to raise here. Instead, I am pointing out that robot love is nowhere near any of these prototypes, meaning it cannot be put on the list and must be either a self-contradiction or at best an entirely new type of relationship we have no exemplar for.

You will recall that Levy's argument was based on the intuition that people are good judges of human behavior and that if a robot acts like it loves you, then it is probably a good sign that it does loves you, especially if it is an intelligent machine that is fully capable of saying the worlds "I love you" coherently in a conversation. But, as it turns out, humans are very bad judges at correctly ascribing feelings of love even in other human lovers.

Gilbert and Jones [20] have studied the tendency of humans to construct their own self-generated reality in which they ascribe true feelings of love to other people even when the evidence is clear that these feelings are unreciprocated. It would seem that people largely assume that another person's beliefs correspond more or less directly with perceived behavior. When someone says "I love you," Gilbert and Jones found that, among their subjects of study, they assumed that the other person actually did love them, even when the spoken words of love are preceded by pleading, such as, "just tell me that you love me" [20].

These findings of Gilbert and Jones give cause to be skeptical that even though one's robot might tell you loud and clear that it loves you and you may believe it with all your heart, that does not at all allow an impartial observer to conclude that the robot actually loves you.

This does not give an a priori argument that robot love is impossible, instead it is just a warning that programmers and designers will find it easier to build a machine that can cause users to believe they are in love without having to solve the much more difficult problem of building a machine actually capable of reciprocal love.

2.2.2 The Ethics of Robot Sex

Since using a robotic sex doll with only limited mechatronics and low level AI is just a very elaborate act of masturbation, the ethics of their use will depend on the ethics of self-gratification. There are numerous cultural and religious constraints to this activity that tend to focus on how these acts may lead to social and or spiritual isolation and therefore masturbation is something to be avoided. In film director Shohei Imamura's 1966 Japanese new wave cinema classic *The Pornographers (Erogotoshi-tachi yori: Jinruigaku nyûmon)*, the protagonist of the film decides near the end of the movie that his life of making pornography and pimping is not solving all the anxieties of his postmodern life, but perhaps building a perfect robotic woman, a "Dutch wife" as he calls it, will help. The character in the film is tragically wrong, the robot proves to be too complex to make, and his obsession with it cuts him off both figuratively and literally from all human contact. In the last frames of the film, we see him floating off on a powerless boat, his robot in pieces, into the vast ocean. Imamura's movie may be as prescient as it is surreal. The thought that robotic lovers may serve to enhance rather than mitigate human sexual pathologies is at least a reasonable hypothesis to explore. Still, in most cultures of the modern world there is an acceptance of masturbation as a common human activity and nothing to get all that worried about, so how could the addition of a robotic accessory to that basic human drive change much?

Let us now look at the question of the psychological health effects of having a sexual relationship with a robotic love doll. While there is quite a bit of psychological research into the

effects of children's play with dolls, there is not much at present in the academic study of how adults interact with sex dolls and robots. One exception is an editorial on sexbots by Joel Snell [13] who is very skeptical of any claims that sexbots will be useful in reducing sexual and marital pathologies; he argues that they will instead increase the instances of various sexual and marital problems encountered in societies today and would therefore not contribute to the common good. Along similar lines is the work of Sherry Turkle [14], who argues that even the limited capabilities of the companion robots available today are causing some of us to mistakenly ascribe human qualities to these technologies and to search in vain to find comfort and companionship where none is to actually be found while ignoring the other humans that surround us. It is obvious that more work needs to be done here. Are sex robots capable of mitigating psychological pathologies or are they contributing to them? If they are mitigating the problems, then creating and using sex robots would be an ethical act. On the other hand, if they contribute to more psychological problems, then their use and design would be morally suspect.

We must also approach the issue from a more philosophical direction and ask about the impact on the quality of our lives that sex robots have in regard to our happiness and concord with the other humans we live with. Coeckelbergh [15] argues that it is important to interrogate what the actions and physical appearances of robots do to humans as social and emotional beings. What he means is that the design of these machines will influence the prospects of their users in achieving human flourishing through a life that is good in a philosophical sense. Coeckelbergh is correct to argue that roboticists use the full force of their imagination to create machines that will enhance the human condition. I have also argued a point that is closely allied with this idea in another work, where I argue that it is better to design robots that enhance human friendships rather than attempt to simply replicate or replace them [16]. Another rather obvious critique of the sex robots that have been built is that they are rather grotesque caricatures of the human form that almost mock the female body in ways that seem to be designed to alienate and intimidate women. These dolls do not live up to the challenge roboethics has made to be imaginative, playful, and, most importantly, friendly with the way robots are designed to interact with people.

Let us now review the argument presented above. The first premise is that the complexity of human sexuality insures that sex robots will mostly be aids for self-gratification. The second premise finds that leading psychologists and social scientists studying this technology argue that sex robots will most likely contribute to psychological disorders [13], [14], rather than mitigating them, as is Levy's hope. The third premise argues that these machines will not help their users form strong friendships that are essential to an ethical society [15], [16], and may indeed lead to more isolation. The final premise points out the fact that these machines, as they are being built today, contribute to a negative body image for real humans through the exaggerated body shapes they now take. It follows from these premises that sex robots, as they are conceived of today, are not likely to be a net positive to society. Simply strapping a silicone sex organ to a washing machine on spin cycle is not much in the way of human achievement, and we seem to be a long way from the sensitive and caring robotic lover imagined by proponents of this technology.

Let us now try to recapture that dream and look at what would be needed to create a robotic lover worth knowing.

2.3 Just Tell Me that You Love Me: Robots and Affective Love

At this point it is important to consider exactly what kind of affective love are we trying to achieve with a robotic companion? Levy [1] has a counterargument for those who might suggest that robots are incapable of affective love.

Levy notes that:

> There are those who will doubt that we can reasonably ascribe feelings to robots, but he believes that if a robot *behaves* as though it has feelings, can we reasonably argue that it does not? If a robot's artificial emotions prompt it to say things such as "I love you," surely we should be willing to accept these statements at face value, provided that the robot's other behavior patterns back them up. When a robot says that it feels hot and we know the room temperature is significantly higher than normal, we will accept that the robot feels hot.... Just as the robot will learn or be programed to recognize certain states—hot/cold, loud/quite, soft/hard—and to express feelings about them, feelings we accept as true because we feel the same in the same circumstances, why, if a robot that we know to be emotionally intelligent says "I love you" or "I want to make love to you" should we doubt it? If we accept that the robot can think, then there is no good reason we should not also accept that it could have feelings of love and feelings of lust [1, pp. 11-12].

Levy has a functional definition of love: If the machine acts like it loves its user and these actions are not inappropriate to the situation at hand, then the robot must actually be in love. This is somewhat like the Turing test where if a machine is capable of having an intelligent conversation with a human, then it must be concluded that the machine has something like human level intelligence [17].

But in both of these cases, "love" and "intelligence" are complex concepts and it is easy to equivocate while trying to adjudicate the results of a functional test. To ward against that possibility we need to quickly review what is known about "love" as a concept.

2.3.1 Cognitive Definitions of Love

We can now turn to cognitive science to see if we can get any clarification on love as a cognitive function. There are a number of interesting theories and we will look at some of the most useful ones here. The first is the *self-expansion* model of love developed by Aron and Aron [21]. "Self-expansion" refers to the feeling of expanded capabilities or opportunities experienced by those engaged in loving relationships. The heart of Aron and Aron's model is the "continuous inclusion of other scale (IOS)," which consists of seven pictures of two increasingly overlapping circles which start separated and then move closer until they start to overlap, much like a Venn diagram, and in the last picture the two circles are nearly indistinguishable [21]. Those engaged in loving relationships can take this test and will both develop a numerical result. This numerical representation of the closeness of the relationship is

correlated with both the feelings and behavior common in close relationships and Aron and Aron argue that the results of this test are highly predictive of whether or not a couple will remain together in the future.

Under the self-expansion model it is claimed that people enter loving relationships to expand their individual capabilities in their social surroundings. This expansion is achieved through increased access to the physical and emotional resources of the lover along with the increases in social status which the relationship might give, as well as access to physical and intellectual abilities that the lover may possess. All of these positive goods are attained in relationship to the closeness of the individuals, which can be measured by the IOS test described above.

We might produce a cognitive map of two individuals engaged in a loving relationship. These maps could detail both of their physical, intellectual, and social capabilities. We could then compare these two maps to find the extent to which these capabilities overlap or fill in gaps in the abilities of the other partner, a process described by researchers as *self-expansion*. Positive results of this cognitive mapping process would indicate a close relationship [22], [23], [24]. Conversely, when this self-expansion plateaus or shows unbridgeable differences between the lovers, then this signals the end of the relationship [25].

Designers of companion robots should take note of this work as it provides a model for regulating a relationship. For instance, this kind of a test might be performed by the machine with its human lover and the machine could work to optimize its IOS by altering its behavior and retesting its human partner until it found itself in an acceptable IOS range. The IOS gives a wonderful measure that designers can use to determine how "loving" their machines are. IOS could be displayed graphically and the user would just select the circle diagram that fits their feelings and, if the number is low, the robot alters its behavior until it gets higher results.

If a robot were able to credibly help a person expand their cognitive and social capabilities while remaining close to its user, then under the self-expansion model it is conceivable that one might legitimately love this machine; however, it is not clear if the machine itself would love its user any more than one might assume a thermostat cares for its user by the evidence that it keeps the house nice and warm.

Another interesting hypothesis is that people enter relationships in order to experience positive emotions and mitigate negative emotions. Those relationships are in trouble when they are dominated by negative emotions. Partners in relationships help to regulate negative emotions that are caused by events outside the relationship [26].

Ortigue and Bianchi-Demicheli have shown through their research that the hypothesized mirror neuron system, which is a cognitive structure believed to be active when one is personally active or is just watching another person act, may play a role in facilitating love and understanding with a beloved by providing evidence of the partners ability to aid in the self-expansion of the lover, and this system may play a role in all prototypes of love [27].[4] Since mirror neurons seem to work through the embodied cognition of the human agent, it follows that robotic engineers should look into this cognitive process and mimic its function in their machines. It also suggest a very important reason to design humanoid robots as it is the perception of the human shape of the beloved that interacts with the mirror neuron system of the human subject. Thus, robots built to interact correctly with the mirror neuron system of their user could lead to the user having authentic feelings of love and bonding toward the suitably programed machine.

In addition to the above models, we can now turn to the evolutionary attachment model of love posited by findings in evolutionary psychology. Both of the cognitive models discussed above can be easily argued from the standpoint of evolutionary psychology to be important contributors to the reproductive fitness of the partners involved in the loving relationship. In this line of reasoning, we see that modes of behavior with positive effects on natural selection will, over time, become deeply embedded in human nature.

Evolutionary psychologists argue that adult romantic relationships may be an adaptation that evolved from the infant-caregiver relationships that formed between mother and child among our prehuman ancestors.

Under this theory, adult loving relationships are explained by the fact that they tend to foster attachment between the partners that can last long term (or long enough to produce successful offspring). The loving relationships can also benefit the survival of the lovers and are formed and strengthened in accordance with how well they provide care and support for those in the relationship. Over evolutionary time both infants and mothers evolved successful techniques to engage the affective states of each other in ways that enhanced survival. Many of the evolved behaviors of both successful infants and successful mothers seem to be used again and recycled in later life to attract and keep mates [28], [29], [30]. The cognitive skills of accurate empathetic responses seem to be the key to maintaining close relationships [31].

We should note here that in this model love is equated closely with empathy and the researchers cited above posit that there is a kind of complex system of communication or signaling between genes that helps to strengthen pairs that are genetically compatible. It must also be mentioned that this theory is still arguable and it may also be the case that complex emotions like love do not map nicely onto some specific set of genes or other inherited structures.

It is also important to mention here that either physical or social evolutionary factors seem to have provided us with the ability to extend our emotional attachments outside our own species. As it turns out, talking to and loving our pets has given our species increased Darwinian fitness, as evidenced by the great symbiotic partnerships our species has formed primarily with dogs but also with many other creatures as well.

Although robotics designers will be interested in tapping into these evolved psychological behaviors for use in building robots that cause their users to experience affection toward them as either pets or humanlike companions, this may turn out to be quite a complex problem, though it is likely that engineers could mimic some of the evolved behaviors that signal empathetic or loving behaviors. Even

4. Mirror neurons are still a hypothesis and not settled fact. If the research cited here proves to be true, it helps strengthen my argument but if not, then the loss of this evidence will not substantially hurt the argument.

with these difficulties, it seems like the field of psychology is fruitful ground for those searching for ideas on the design of affective computing solutions for robotic companions. In these models, love has functional characteristics that can be modeled and duplicated to some degree using robotics.

2.3.2 Philosophy and Love

While the roboticists working in the area of artificial companions have paid some attention to human psychology, they have largely ignored the contributions of philosophy to the study of love or the erotic. Philosophy has a long tradition of exploring love and the place of the erotic in the well lived life. While psychology is an important tool in determining what love is in humans, how it is expressed, and its ultimate role in the evolution of our species, we need to look to philosophy to try to understand what love ought to be, the aesthetic value of love, and its role in achieving an ethical and happy life. A companion robot would be of less value to us if it was only able to mimic the psychological aspects of love and not address the more important philosophical meanings of love.

A full account of the philosophy of love would require volumes worth of careful work. That is not possible here and instead I must admit that I will hand pick the citations I do use to suit my argument. What I hope to achieve is a provocative sampler for robot programmers and designers which will help them see that there are important aspects of the philosophy of love missing in their work so far. Other authors would have chosen their own favorites and I hope that others will add to this project and suggest aspects of the philosophy of love that they find personally valuable or motivating.

I will start by looking at the work of Plato since he argues that love is best seen as a way to expand the moral horizons of the lover. The question here is if Plato is correct and love makes one morally better for having loved, is this true of loving a machine? Are we morally better for having fallen in love with a machine? Or, put another way, have we attained anything of moral worth if we enter a relationship that was preprogrammed to succeed?

In the *Symposium* [32], Plato has given us one of the great discourses on love and we would be remiss if we did not give it at least some attention here.

In this dialogue, Socrates finds himself at a gathering where the wealthy and learned men of Athens have decided to talk on the subject of love. The guests take turns presenting their theories and many of the discourses on love offered up by Socrates' interlocutors fall into the folk definitions of love that we discussed earlier. Included in this discussion is the famous soliloquy by Aristophanes, who tells of an enduring myth where every human is looking for its other half that was split from it by the gods; thus the purpose of love is to complete the individual. After these stories Socrates finally tells his own accounting of love as it is personified in the being of Eros.

Socrates explains that Eros is not actually a god, which means he is neither entirely beautiful nor entirely good but he is also neither completely ugly nor bad. He is a daemon, which for the Greeks was an entity that existed between the gods and man [32, pp. 31-32].

Eros is a strange sort of supernatural being who inherited qualities from his parents who could not have been more dissimilar. His mother was Penia, the goddess of poverty, and his father was Poros, the god of resource. They had a drunken affair at the party celebrating the birth of Aphrodite. Thus, the offspring of that affair, Eros, is a mixture of poverty and resource, he is both fulfilling and needing, neither wise nor fully lacking in understanding [32, p 34]. Here, Socrates is arguing that love is something that is both fulfilling yet desperately needy as well.

In a surprising turn of events Socrates makes the claim that indeed the qualities of Eros make him a philosopher; he needs beauty and truth from the beloved to fulfill what he lacks in both on his own, just as the philosopher seeks beauty and truth in knowledge, a quest that would be unnecessary if the philosopher already had these qualities [32, p. 35]. Love is the active pursuit of things that are actually beautiful and good and in this way true love is a philosophical undertaking. Socrates then makes the audacious claim that he, as ugly as he is, is therefore the most erotic man in Athens given his unrelenting quest to find the truth and beauty he lacks as an individual. He concludes that the best of us are motivated by the erotic, which is the desire to find and the ability to distinguish true truth and beauty.

What we can learn from this is that erotic love has an important role to play in the philosophical life. While at one level love can simply be of instrumental value in the survival of the individual and the gene, at another level it is also something that can make the lover better as a person; the fulfillment of the beloved brings with it further longing, which spurs the lover on to other achievements in the endless quest for the erotic.

There has been much added to this topic since the time of Plato, too much to be fully covered here, but there are some thoughts from Irving Singer, one of the foremost thinkers in the contemporary philosophy of love and sex.

In his book *Explorations in Love and Sex* [33, p. 114], Singer explains that, "Love, like the creation of meaningfulness in general, reveals the ability of life in general—above all, as it appears in human beings—to bestow value on upon almost anything that catches our attention and makes itself available for this unique mode of self-realization." What Singer is saying here is that love has to have meaning or it is not love, but that the state of being in love can heighten our awareness of the inherent value of what we find around us.

Singer also describes an interesting evolution of the philosophy of passionate love that has occurred in the last century. In the 20th century, passion moved from being something that was somewhat philosophically suspect, as one can see even in Plato's *Symposium*, to being something that was believed to bring happiness and fulfillment to one's love life [33, p. 219]. This means that modern philosophers are more likely to agree that it is possible for a passionate love to be one that draws the lovers toward the philosophically erotic goals of seeking truth and beauty, whereas before it might have been seen as the kind of activity that might throw one off the track of the proper pursuit of truth.

Along with this change in philosophical attitude there has been a profound change in the technologies of birth control and other reproductive technologies which have indelibly changed the role that sex plays in a marriage and

loving relationship. As sex is decoupled from procreation, it can now serve primarily as a mode of expressing love and sexual freedom, which found its apex in the sexual revolution. The epochal changes brought about by the sexual revolution has also had to confront the great tragedy of the AIDS epidemic, and together these have transformed what people now want from loving relationships. Singer argues that these changes have caused a deeper concern for finding compassionate loving partners instead of looking only for short term passionate affairs [33, p. 219]. So except for the relatively brief period when the sexual revolution was at its height, erotic love is now seen as an expression of compassion that must include qualities like tenderness, sociability, benign concern, and general good will between the lovers. Singer feels that this change is adding a deeply moral dimension to romantic love [33, p. 219].

A robotic companion worth having would somehow need to provide the kind of moral and compassionate love that we have come to expect from erotic relationships. This requirement may be the most difficult quality for roboticists to achieve through programming. As we have seen in the section on robotic sex, it is likely that roboticists will be able to create a machine that might raise the passions of certain users, but that may not be enough for the development of longer term relationships since this would require compassion and the philosophically erotic. We don't need just a machine to have sex with, we need one that makes us and the robot better by being with one another. We will have achieved nothing of moral worth by building machines that provide us with less as they will distract us from the more valuable pursuit of the kind of love that will expand or moral horizons through the experience of authentic love.

3 Robotic Lovers

So far we have seen that it is quite likely that sex robots with modest AI abilities are already on the market and there will no doubt be many innovations added to make them more and more life-like. But there have also been some interesting developments in the area of robots designed not for sex but to instead elicit love and affection from their users as a pet might do.

Lovotics is the conscious attempt to form a bond of love between the user and the robot and is the brain child of Hooman Samani from the Interactive and Digital Media Institute at the National University of Singapore [34], [35], [36], [37]. Lovotics is perhaps the most extensive project in affective robotics today where the researchers are directly applying psychological and physiological research on love in the development of their robotic systems. It is very difficult to determine how much of the claims made by the researchers involved in lovotics are real or hype. This is a problem that is widespread throughout the robotics community, where often clever YouTube videos serve to advance the excitement in some machine that in reality does not perform nearly as well in person as it does on a well-edited video.[5] If we take them at their word, lovotics attempts to simulate the physiological reactions of the human body experiencing love through an "Artificial Endocrine System," which is a software model of the same systems in humans which include artificial "Dopamine, Serotonin, Endorphin, and Oxytocin" systems [34], [37]. Layered on top of this is a simulation of human psychological love, very similar to what has already been discussed in this chapter. As the lovotics website [35] explains, their "Probabilistic Love Assembly" consists of an AI psychological simulator that

> ...calculates probabilistic parameters of love between humans and the robot. Various parameters such as proximity, propinquity, repeated exposure, similarity, desirability, attachment, reciprocal liking, satisfaction, privacy, chronemics, attraction, form, and mirroring are taken into consideration.

A robot designed under these principles will then monitor its user and inductively reason the mood of the user through evidence such as facial recognition and analysis of body language and physiology. It can then alter its own behavior in an attempt to maximize the affection and loving behavior of its user.

As of this writing they have developed a few robotic systems based on their findings.

Their first machine was a little furry robot that fans of the science fiction series *Star Trek* might mistake as a *tribble*. This machine is a robotic pet that moves around flat surfaces and coos gently to its owner while emitting a different colored glow of light to signal its mood.

A more ambitious machine designed by this lab is "Kissenger," which is a small spherical machine with a cartoon inspired face that looks something like a cross between a pig, a rabbit, and a panda. In the middle of the face is a big pink set of lips. If you were to have one of these machines you could link up through the Internet with another one just like it that you and your lover could use to share a kiss as your interactions with the robot's lips are mimicked on the machine of your internet lover and vice versa [34]. The designers of Kissenger see three potential uses for the machine.

Kissenger enables three modes of interaction:

1. Human to Human tele-kiss through the device: Bridges the physical gap between two intimately connected individuals. Kissenger plays the mediating role in the kiss interaction by imitating and recreating the lip movement of both users in real time using two digitally connected artificial lips.
2. Human to Robot kiss: Enabling an intimate relationship with a robot, such technology provides a new facility for closer and more realistic interactions between humans and robots. In this scenario, one set of artificial lips is integrated in a humanoid robot.
3. Human to Virtual character physical/virtual kiss: Provides a link between the virtual and real worlds. Here, humans can kiss virtual characters while playing games and receive physical kisses from their favorite virtual characters. Further, Kissenger can be integrated into modern communication devices to facilitate the interactive communication between natural and technologically mediated environments and enhance human tele-presence [34].

5. The author is not endorsing Lovotics or any similar affective robotics product and Lovotics machines are mentioned only to provide an example of recent technologies attempting to design machines capable of reciprocal love through mimicking and manipulating human psychology.

Not quite a full erotic or romantic relationship with an artificial being, but you can see that is the eventual goal toward which Kissenger is a first step.

Another strange, yet interesting robot that the lovotics group is working on is the "Mini-Surrogate," which is a small doll-like caricature of the user that you give to your distant lover. You would also have one that resembles the other user you are in a relationship with and these dolls would then stand in for you and your lover by mimicking your body language, thus facilitating both of the user's telepresence with each other. As the designer's explain:

> Current telecommunication techniques lacks the holistic embodied interaction and interface. The feeling of nonmediation can be reinforced in remote interpersonal communication if the interaction is through the whole body and engaging, interactive physical representative of each person is available in close proximity of the other person. The reason is related to the significance of embodiment, anthropomorphism, proximity, and enjoyment in fostering the illusion of presence [34].

One could also imagine that the mini-surrogate could also stand in for virtual characters as well just as the Kissenger is designed to do. The mini-surrogate is very mechanical in its motions and comes off more comical than romantic, but one can imagine a better built and far more expensive machine that might serve a role similar to the Kissenger but capable of *tele-sexual-relations* (to coin a somewhat cumbersome term) that could be linked to another human user or a virtual character in a game or other application.

These machines have received extensive media attention and the lovotics group has produced numerous academic papers and given many presentations on their work. Thus, they are arguably the most active research center working specifically on robot love today.

Hiroshi Ishiguro is another strong contributor in the area of robotic companions. His work at the Intelligent Robotics Laboratory at Osaka University [38] and at Hiroshi Ishiguro Laboratory ATR [39], while not directed specifically at robotic love, is creating some compelling androids and humanoid robotic applications that are intended to elicit and interact with human emotion. For the Valentine's Day 2012 shopping season, Ishiguro showcased his android *Geminoid-F*, who sat in the store window of Takashimaya department store in the Shinjuku district of Tokyo in front of a huge heart shape formed by dozens of boxes, each decorated by little hearts. Geminoid-F is an android made to look like a human female and its face and clothing are modeled after a real person who works in the lab with Ishiguro. When this machine has been shown it has typically been teleoperated, but in this appearance it seems to have been programmed to engage with human observers by coyly sharing glances with them then turning away, all designed to draw the observer in to try to figure out this mysterious female machine.[6]

There are many other androids in the Geminoid series, including one that looks exactly like Professor Isiguro himself [39]. These androids are far more compelling than anything else discussed in the paper so far, but they are not fully out of the discomfort induced by the uncanny valley that many of the more realistic humanoid robots fall into [40], [41]. The high level of artistic and engineering achievement that Ishiguro has achieved with these machines points toward a future in which very realistic android robots may find their way into the home as companions, but still, as they stand today, they are something that only their creator could truly love and their repertoire of behaviors is still somewhat lacking.

3.1 Robotic Design Strategy

From the review of robotic companion technologies we have gone through in this chapter we can see that there are at least two existing design strategies that have been successfully deployed in affective companion robots. While both of the following design strategies might be discussed in robotics engineering as "sociable" or "social" robotics, I believe that, for conceptual clarity and to make the philosophical points I want to make, we need to refer to at least two different types of social robotics design strategies.

3.1.1 Robotic Design Strategy One—Variance

The first successful design strategy is to work toward a more or less harmonious integration of the robot with its user and surroundings. These machines would be to simulate emotion and embodiment in the machine in a way that is not a direct imitation of the human, though it may be inspired by the study of human emotion. When this strategy is successful, the user(s) will feel more comfortable working or interacting with the machine, and the machine will more seamlessly fit into human society. We will call this the "variance" strategy as the designers of the robot seek to build a friendly working relationship between the robot and the humans it is built to interact with. In this strategy, one builds and programs the machine with a generally human appearance and behavior so that it can use its limbs and visage to suggest moods through body language and facial expressions which will be meaningfully interpreted by any human user. Ideally, this will help facilitate verbal communication and ease user exasperation when the shared project might run into obstacles, and this strategy is growing in use [42], [43], [44], [45], [46], [47], [48], [49], [50]. The primary distinction between this strategy and the next is that these machines interact with their users as machines and not as surrogate humans. They do attempt to navigate human emotion with affective computing applications and they may even fulfill the role of robotic companions, but there is a certain distance maintained between the robot and the expectations of the user; they look and act more or less like machines so the user expects less human verisimilitude from them.

3.1.2 Robotic Design Strategy Two—Mimesis

The second is to make a much stronger appeal to the user's emotions in order to have the user treat the machine as if it were a fellow human agent or at the very least to have the user be momentarily confused as to whether or not the robot is a human or an android and this is the strategy we can argue is employed in the Roxxxy sex robot as well as the much more complex Geminoid androids. Another good example of this is the Actroid DER2 that has been built by Kokoro, a division of Sanrio that specializes in animatronics

6. Video of the exhibition can be found here: http://www.youtube.com/watch?v=hCaRkyq02go.

and robotics. This robot is meant to be used as an artificial actress or newscaster, so it is not technically an artificial companion, but the technology being developed here could be applied elsewhere.[7] This is just a short list of the mimetic androids in development; there are many others we could mention but the ones we have looked at so far are the best of what is available.

The proponents of what we can call the mimetic robotics style of design argue that if our goal is to build complex artificial agents that we can exist in close contact with, then these machines are going to necessarily be more or less indistinguishable from humans [1], [51], [52].

It is also important to remember that both design strategies can be employed in a single company or lab, but they are mutually exclusive at the level of the individual system. A particular robot cannot be both variant and mimetic.

3.2 Apparent Affective Artificial Agency

If our goal is to build complex artificial agents that we can exist in concord, then both of the variant and the mimetic strategies could serve as methods with which to explore how to give these agents robust and authentic emotional responses [53]. But it is too easy to become enamored of this eventual goal and disregard the long interim period where these machines will be able to effectively simulate but not actually synthesize human emotion and romantic behavior. The affective capabilities of these machines will be apparent and somewhat accurate but it will not be an adequate substitute for human relationships. This is why we should endeavor to make machines that can help enhance human relationships but we should avoid making them to simply replace the humans in our lives.

For some people, computers and other bits of machinery have already passed a sufficient affective threshold and provide enough stimuli for the human user to form deep emotional attachments to machines and artificial agents.

Turkle [14] has written extensively about individuals who, for various psychological reasons, prefer the company of computers to other people. She argues that perhaps these people are not psychologically damaged but instead they may be best seen as early adapters and that they provide us a view of the future of human-machine interpersonal relations.

Computing technology is such a compelling surrogate for human interaction because it is so malleable to the wishes of its user. If it does not do what the user wants, then a sufficiently trained user can reprogram it or fix the issue to make the machine perform in line with the user's wishes. With a little work, the experience between the user and the machine can be completely personalized to every conceivable user. A person who is smart with the technology can get it to do what he/she wants when he/she wants it.

Fellow humans, on the other hand, represent a much more difficult problem and do not always readily change to accommodate one's every need. They provide resistance and have their own interests and desires that make demands on the other person in the relationship. Compromise and accommodation are required and this is often accompanied by painful emotions.

If we follow this line of reasoning, then it would seem that more and more of us will take the path of least resistance and chose to interact more and more with digital technology over other human beings if given the choice.

Levy believes that this logic is irresistible and that as the technology of robotic lovers improves and becomes easier to use, cheaper to deploy, and fulfills more of our needs, then humanity will drift en masse toward the happier and more fulfilling world of robot love.

3.3 Taking HCI to the Extreme

Let's sum up our findings so far.

1. Psychological factors in love, sex, and attraction can be at least functionally duplicated in robotics technology.
2. Humans have a psychological tendency to anthropomorphize animals, objects, and technologies.
3. Evolution has given us a predisposition to be interested in developing caring relationships for creatures outside our own species
4. If someone acts like they loves us, even if those actions are very minimal, we will tend to believe they truly do love us.
5. Early adaptors have already begun to prefer human-computer interaction to interaction with fellow humans.
6. So, by extrapolation, a robot that can tap into these psychological tendencies would attempt to form relationships at least as real and moving as those we have with our beloved pets.

This takes us to the final step of Levy's argument. If indeed a robot came into peoples' lives, and that machine could meet their every psychological need, fulfill every sexual desire, and enjoy all the same things as their owners, then certainly society would be forced to recognize human robot love and possibly even human robot marriage. Levy also assures us that the robot in our example would itself genuinely want its user as its spouse.

Because, by design, the robots only desires would be to please its user and only its particular user, the robot would be functionally unhappy in any other situation, with another user perhaps, or removed from the company of the user it is programmed for. So, Levy argues it would be a kind of cruelness and a mistreatment of the robot if it were not allowed to love and serve its owner.

Levy's argument here begs a number of technological questions. Judging from what is on offer today, it is highly unlikely that we will be able to build a machine that can have the functionality it would need to have complex self-referential thoughts about thoughts and desires about desires. But even if we grant the remarkable technological advances that would be needed to create such a highly functioning robot lover, there is still an important ethical issue to answer. Just because one builds a love slave that wants to be a love slave does not absolve the master from the moral charge of slavery.

Given that this is not a short term concern, let's instead look at the more likely ethical impacts of affective robotics in the area of robotic companions.

4 Ethics of Robotic Love

One thing that should be abundantly clear is that affective robotics, as it appears today, works best by manipulating

7. http://www.kokoro-dreams.co.jp/english/robot/act/index.html.

human psychology. It seems that humans have a number of evolved psychological weaknesses that can be leveraged to make a user accept simulated emotions as if they were genuine. It is unethical to play on deep-seated human psychological weaknesses put there by evolutionary pressure as this is disrespectful of human agency [54].

If it is true that this technology causes people to grow less and less tolerant of human relations, then we have to be very careful of this technology. It would be a human tragedy if we lost our tolerance to deal with others who are not preprogrammed to serve our every need.

The design of technologies must not try to overly abuse the distinction between human, natural, and artifactual systems [55]. This would suggest that we should be very careful with the mimetic design strategy.

As we have seen, Levy and other roboticists have so far ignored the deep and nuanced notions of love and the concord of true friendship as described in philosophy. While it is given that robots can be built that people will find sexually attractive, it is unlikely that a machine can be built that will be capable of building an erotic relationship between itself and the user. Instead, with these technologies as they are currently evolving, we have an engineering scheme that would only satisfy, but not truly satisfy, our physical and emotional needs, while doing nothing for our moral growth

4.1 Ethical Design Considerations

1. Love is more than behavior. It is important to design robots so they act in predictably human ways but this should not be used to fool people into ascribing more feelings to the machine than they should. Love is a powerful emotion and we are easily manipulated by it.
2. Friendship (philia) with robots is more important than romantic love. It is permissible and even desirable to design robots that act in concord with their users; affective friendship will be a hard enough to achieve so we should start there. Given that we will be able to mimic emotions in a robot long before we will be able to produce truly affective machines, it is advisable to be circumspect in how we exploit human psychology in the design and deployment of these machines.
3. Truth is Important. Roboticists should not design machines that intentionally lie to their users and with those lies manipulate the user's behavior.

5 Criticism to This Argument

There are two common criticisms to my argument above that I would like to rebut here. The first is the claim that humans lie to each other all the time, especially when it comes to sex and romance, so why would I want to place special ethical restraints on roboticists when they are just playing along with a game as old as time.

First, this criticism is simply a version of the naturalistic fallacy. Just because something occurs often in nature does not necessarily make it the most rationally ethical choice. While roboticists can and should look to natural systems for inspiration and insight, it would be silly to think that they are limited to only modeling naturally occurring systems. Even if every human relationship was based on lies and deceit, it might still remain possible that another—more truthful—mode of behavior might be discovered through social scientific research. Arguably, human political systems have evolved from less ethically justifiable modes of behavior through fits and starts to modern systems which, while far from perfect, are at least stronger from a moral standpoint. So we do not have to accept base and deceitful behavior from either the designers of these machines or the robots themselves. We can and should demand better from these systems.

The second common misunderstanding I have received when presenting this argument is the presumption that I am against the fulfillment of romantic desire. How could I turn my back on a technology that could bring us perfect love?

It is easy to see that this criticism begs the question. If you can create a perfect love, then of course I could not argue against it. What I am saying instead is that we have to be careful to not mistake simulacral love for the real thing. I agree that this technology will be compelling and in fact already is compelling to some early adopters. But the kind of relationships that are evolving are not philosophically erotic, that is, challenging and compassionate, but rather one-sided affairs overburdened by fleeting passions and the desire to erase everything in the beloved that is not a complete reflection of the lover's preconceived notions of what he or she thinks they want out of a partner. Remember the main lesson Socrates was trying to give us in the *Symposium* is that we come into a relationship impoverished, only half knowing what we need; we can only find the philosophically erotic thorough the encounter with the complexity of the beloved, complexity that not only includes passion, but may include a little pain and rejection from which we learn and grow.

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