11

Robots in Society

What is covered in this chapter:

- The influence of the media on human–robot interaction (HRI) research;
- Stereotypes of robots in the media;
- Positive and negative visions of HRI;
- Ethical considerations when designing an HRI study;
- Ethical issues of robots that fulfill a user's emotional needs;
- The dilemmas associated with behavior toward robots (e.g., robots' rights to being treated in a moral way);
- The issue of job losses as a result of the increasing number of robots in the workforce.

The discussion of robots in society often brings up questions about how we envision robots in the present and future and the social and ethical consequences of using robots in different tasks and contexts. Researchers, the media, and members of the public argue over how robots will affect our perceptions of and interactions with other humans, what the consequences of new robotic technologies will be for labor distribution and relations, and what should be considered socially and ethically appropriate uses of robots. This kind of exploration is crucial to the field of human–robot interaction (HRI) because understanding the societal meaning, significance, and consequences of HRI research will ensure that new robotic technologies fit our common social values and goals. To understand how robots might fit into society, we take a broad view of HRI through the lens of culture and the narratives, values, and practices that provide the context and tools with which people make sense of the world around them and the robots that will be coming to share it.

In this chapter, we look at robots in fiction and film, two aspects of popular culture that have had particularly strong impacts on how we imagine robotic technology in society. We also consider ethical concerns about the introduction and use of robots in society to reflect on how our values and priorities should be taken into account while shaping the human–robot interactions of the future.

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11.1 Robots in popular media

What movies have become popular with audiences or critics recently? Is there a TV series that went viral or an episode that everyone is talking about? Did any of those contain robots, by chance? If so, how were these machines portrayed? Looking into the literature and other media, it becomes clear that robots have always been a "hot topic" for sci-fi writers and avid consumers.

Historically, stories of artificial human beings, such as the Golem in Jewish folklore, have been around for hundreds of years. Karel Čapek was the first author to use the word "robot," which was featured in his theater play *R.U.R.—Rossum's Universal Robots* that premiered in 1921 (see Figure 11.1). In it, robots take over the world and kill almost all humans. Two robots do, however, start to exhibit emotions for each other, and the last remaining human considers them to be the new Adam and Eve.

Figure 11.1 A scene from Čapek's 1921 play *R.U.R.* shows robots rebelling against their human masters.

Now think back to when you first heard about robots—this first encounter with a robot was likely an on-screen encounter. Computer graphics can nowadays visualize almost anything; hence, depictions of robots in movies can be quite fantastical. For example, movies depict robots that use antigravity to float around. In reality, there is little use for such robot hardware features. Robots have been portrayed in all types of artistic expressions, such as books, movies, plays, and computer games. Such media portrayals form our perceptions and understanding of robots and can thus bias our views, particularly because these are the only experiences most people have with robots. We are at an interesting point in time where, on the one hand, more and more robots are about to enter our everyday lives, but on the other hand, almost all our knowledge about robots stems from the media. This gap between the expectations fueled by science fiction and the actual abilities of robots often leads to disappointment when people interact with robots. This is why it is important to look at how robots are portrayed in popular media and to take such portrayals into account when we are designing robots for and presenting them to the public.

As a disclaimer, we have to acknowledge that it was not possible for us to consider every robot mentioned in every book, film, computer game, newspaper article, or play. Their number vastly exceeds our limited capacity for processing. But an exhaustive review is, in our view, not even necessary. We believe that we can still draw some valid conclusions from representative samples of robots in the media.

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11.1.1 Robots want to be humans

In many stories, robots are portrayed as wanting to be humans, despite their own superiority in many aspects, such as strength and computational power. This desire to become human is the central story line for Isaac Asimov's *The Bicentennial Man*, in which a robot named Andrew Martin is following a lifelong plan to become recognized as a human (Asimov, 1976). The book was the basis for the movie of the same name, released in 1999. Besides becoming physically more humanlike, Andrew Martin also fights a legal battle to gain full legal status. He is even prepared to accept mortality to gain this status.

Other robots, such as the replicant Rachael in the movie *Blade Runner* based on the book by Philip K. Dick, are not even aware of the fact that they are robots (Dick, 2007). The same holds true for some of the humanlike Cylons in the 2004 TV series *Battlestar Galactica*.

On the contrary, a prime example of a robotic character that is aware of its robotic nature is Mr. Data from the TV series *Star Trek: The Next Generation*. Mr. Data is stronger than humans; has more computational power; and does not need sleep, nutrition, or oxygen. Still, his character is set up to have the desire to become more humanlike. The key aspect, however, that makes Mr. Data different from humans is his lack of emotion. Similarly, Steven Spielberg's movie *A.I.*, based on Brian Aldiss's short story *Super-Toys Last All Summer Long*, accepts this main premise of a lack of emotion as well (Aldiss, 2001). Because robots lack emotions, Professor Allen Hobby, played by William Hurt, builds the robot David with no ability to love. Likewise, sci-fi authors have considered emotions to be a feature that all robots would lack. However, in reality, several computational systems of emotions have already been successfully implemented. The computer programs implementing the so-called *OCC model of emotions* (Ortony et al., 1988) are prime examples. Equipping robots with emotions in the attempt to make them human is therefore an archetypal story line.

A more subtle variation of this story line is the inclusion of a control or setting for honesty and humor in the robots depicted in the movie *Interstellar*. The following dialogue between Cooper, the captain of the spaceship, and the TARS robot emerges:

COOPER: Hey, TARS, what's your honesty parameter?
TARS: Ninety percent.
COOPER: Ninety percent?
TARS: Absolute honesty isn't always the most diplomatic nor the safest form of communication with emotional beings.
COOPER: Okay, ninety percent it is.

Although robots might not have emotions themselves, they will be required to interact with humans that do have emotions, and hence it

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will be necessary for them to process emotions and even adjust their rational behavior accordingly.

These archetypal examples taken from contemporary film are only the tip of the iceberg, but they illustrate humans' steady desire to compare themselves to superhuman entities. A hundred years ago, however, there were already machines that were more powerful than humans, although their power was physical and not mental. These days, we can see the major progress in the area of artificial intelligence AI). On May 11, 1997, the IBM computer "Deep Blue" won the first chess match against the world champion at the time. In 2011, the IBM computer Watson won as a contestant in the quiz game show *Jeopardy*. In 2017, Google's DeepMind AlphaGo defeated the world's number-one Go player, Ke Jie. In light of this progress, it is easy to imagine how robots in the future might be both strong and intelligent, leaving humans in an inferior position. At the same time, computers and robots are successful in limited task domains, so humans may have the advantage through their ability to adapt and generalize to different tasks and contexts. Fictional narratives let us explore the consequences of these and other possibilities from the safety of our couches.

11.1.2 Robots as a threat to humanity

Another archetypal story line in fiction is that of a robotic uprising. In short, humanity builds intelligent and strong robots. The robots decide to take over the world and enslave or kill all humans in order to secure resources for themselves (Barrat, 2015). Karel Čapek's original play, mentioned earlier, already introduced this narrative. Going back to the example of Mr. Data, he has a brother named Lore that possesses an emotion chip. Lore follows the path of not wanting to be like a human but instead wanting to enslave humanity. Other popular examples are *The Terminator* (Cameron, 1984) (see Figure 11.2), the Cylons in *Battlestar Galactica*, the Machines portrayed in the movie *The Matrix*, and the robots portrayed in the 2004 movie *iRobot*. The latter is based on the book by the same name by Isaac Asimov (Asimov, 1991). Asimov coined the term "Frankenstein Complex" to describe this archetypal story line.

Figure 11.2 The Terminator. (Source: Dick Thomas Johnson)

This archetype builds on two assumptions. First, robots resemble humans. The robots depicted in these movies have been designed to look, think, and act like their creators. However, they exceed their creators in intelligence and power. Second, once they interact with the now "inferior" human species, robots dehumanize their subordinates, a theme familiar in examples from human history as well. Many colonial powers declared indigenous populations as nonhumans in an attempt to vindicate the atrocities committed toward them. Accordingly, because robots resemble humans, they will also enslave and kill humans. How-

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ever, this rationale is overly simplistic. The issue of a perceived threat to distinctiveness is also addressed in the psychological literature (Ferrari et al., 2016). If you want to learn more about the psychology of feeling threatened by robots, then consider reading the work of Zlotowski et al. (2017).

11.1.3 Superior robots being good

Several science-fiction authors have already proposed future scenarios in which superior robots quietly influence human society. In Isaac Asimov's *Prelude to Foundation*, he describes a robotic first minister, Eto Demerzel (a.k.a. R. Daneel Olivaw), who keeps the empire on the right track (Asimov, 1988). Interestingly, he hides his robotic nature. He is a very humanlike robot in appearance but resorts to various strategies to blend in. For example, he eats food, despite the fact that he cannot digest it. He collects it in a pouch that can be emptied later. Here we have a scenario in which a superior being works to help human society behind the scenes.

The notion of robots being evil and humans being good is most persistent in Western culture. Robots are extremely popular in the Japanese media, and there we can observe a different relationship between humans and robots: robots, such as "Astro Boy" and Doraemon, are good-natured characters that help humans in their daily lives. This more positive spin on the social uses and consequences of robots is often seen as being partially responsible for the large number of personal and home robots being developed in Japan and their perceived higher acceptance there than in Western societies.

11.1.4 Similarity between humans and robots

The story archetypes described previously all explore the question of to what degree humans and robots are alike. From a conceptual point of view, robots are typically portrayed by emphasizing either their similarities or lack thereof in terms of their body and mind (see Table 11.1). Dixon supports this view by stating that artists explore the deep-seated fears and fascinations associated with machine embodiment in relation to two distinct themes: the humanization of machines and the dehumanization of humans (Dixon, 2004; Haslam, 2006).

		Mind	
		Similar	Different
Body	Similar	Type I	Type II
	Different	Type III	Type IV

Table 11.1 Topics of HRI in theater

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These four types of topics can, of course, be mixed. If we take the example of Mr. Data, at the superficial level, he looks very much like a human, which sets our expectations accordingly (Type II). It then appears dramatic and surprising if Mr. Data is able to enter the vacuum of space without being damaged. In the movie *Prometheus*, the android David, played by Michael Fassbender, is wearing a space suit when walking on an alien planet. Wearing this suit does not serve a functional purpose because David does not require air. The following dialogue emerges:

CHARLIE HOLLOWAY: David, why are you wearing a suit, man?
DAVID: I beg your pardon?
CHARLIE HOLLOWAY: You don't breathe, remember? So, why wear the suit?
DAVID: I was designed like this, because you people are more comfortable interacting with your own kind. If I didn't wear the suit, it would defeat the purpose.

Again, the human embodiment sets our expectations, and when a difference from humans is displayed, it surprises the audience. Godfried-Willem Raes takes a different approach with his robot orchestra. He emphasizes the equality of robots and humans in his theatrical performances (Type I). He argues:

> If these robots conceal nothing, it is fairly self-evident that when their functioning is made dependent on human input and interaction, this human input is also provided naked. The naked human in confrontation with the naked machine reveals the simple fact that humans, too, are actually machines, albeit fundamentally more refined and efficient machines than our musical robots.

An example of Type III could be Johnny Five from the 1986 movie *Short Circuit*. Although Johnny Five has a distinctively robotic body, he does express human emotions, which suggests that his mind is similar to that of humans.

11.1.5 Narratives of robotic science

Ben Goldacre has pointed out how the media promotes the public misunderstanding of science (Goldacre, 2008). Two narratives that the media frequently uses are science-scare stories and wacky science stories.

The performance of autonomous vehicles, which can also be considered a form of human–robot interaction, is currently the target of immense scrutiny. The crash statistics provided by Tesla, Waymo, and others indicate that they are performing better than humans. Tesla,

for example,[1] showed that driving using the vehicle's autopilot feature reduces the probability of crashes dramatically. This finding does not, however, take into account that Tesla's autopilot currently does not operate in urban environments. The comparison to the overall crash statistics is therefore problematic. Still, the accidents that do occur attract disproportional attention in the news. Most cases even attract international news coverage, such as the lethal Uber crash in 2018. This attention may affect and possibly inhibit the adoption of this technology.

One question that almost all reporters ask when interviewing HRI researchers is when robots will take over the world. The goal, then, is to write a story that scares the public and hence attracts attention. A story entitled "Robots are harmless and almost useless" is very unlikely to get published. But that is what most HRI projects come down to at this point in time. The question of when and if robots will take over the world addresses our inner fears and fascinations involving interacting with robots. Are we like robots? Are robots like us? And if so, will superior robots act as badly as humans have when encountering "inferior" beings?

We may ask ourselves why these questions are so persistent in the media. The most obvious answer is that stories need to have a conflict to generate tension. A fictional world in which everybody is happily living together is unlikely to capture the attention of the audience. Pitching evil robots against good humans not only serves the purpose of creating a conflict but also triggers an "in-group" effect. We humans feel that we need to defend our species against "out-group" robots. This division can then be challenged by introducing robots that are indistinguishable from humans, such as in the TV shows *Battlestar Galactica* and *Westworld*. This creates great uncertainty, which in turn creates tension. Notable exceptions from the gloomy visions in the media are the TV series *Futurama* by Matt Groening and the movie *Robot and Frank* by Jake Schreier, both of which depict a vision of the future in which humans and robots live peacefully side by side. They even become friends. In the movie *Her*, the protagonist Theodore, played by Joaquin Phoenix, even falls in love with his AI mobile phone Samantha (Jonze, 2013).

The wacky science narrative occurs less frequently but attracts attention nevertheless. A robot preacher that "can beam light from its hands and give automated blessings to worshippers" is just one example of a newspaper story that is intended more to entertain than to report scientific progress (Berghuis, 2017).

For HRI researchers, media coverage therefore has great potential to showcase their work, but it also carries considerable risk. The reporter

[1] https://www.tesla.com/blog/q3-2018-vehicle-safety-report

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might intend to write a scare story or a wacky science story. Researchers are therefore advised to participate in the media training sessions that many universities and research institutes offer to their staff. A general guideline for talking to the media is to stick to the research that was actually performed and avoid engaging in wild speculations about topics that were not covered in the study at hand. It is also always a good idea to ask which questions will be asked beforehand and, when possible, to request to view a manuscript draft prior to publication so that any misunderstandings or misrepresentations of the science involved can be corrected prior to publication.

HRI researchers cannot shy away from representations of robots in the media, fictional or otherwise, and the elicitation of associated fears. In HRI studies, we invite people to engage with robots, and every single person who interacts with a robot does so with preconceptions and expectations of what the robot can and cannot do. Many of these come from science fiction and reports in the media, rather than the annals of scientific research.

11.2 Ethics in HRI

Is it okay to develop and sell a sex robot, which is always willing to do what you want and will stay forever young and fit? Would you have your parents be taken care of by a carebot instead of a human nurse?

Roboticists and philosophers alike have long been concerned with such ethical issues in robotics, coining a shared domain of scholarship called "roboethics." More recently, a group of HRI scholars formulated five ethical rules, which they call their Principles of Robotics, to raise broader awareness about the role of ethics for HRI.[2] Ethical rules have also been a subject of discussion in popular literature, particularly the well-known "Three Laws of Robotics" (see the accompanying text box).

Isaac Asimov (January 2, 1920–April 6, 1992; see Figure 11.3) proposed three rules of robotics that would safeguard humanity from malevolent robots:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Although Asimov's work is highly visible in the public media, it has

[2] `https://www.epsrc.ac.uk/research/ourportfolio/themes/engineering/activities/principlesofrobotics/`

been criticized by philosophers. Asimov eventually added a zeroth law:

0. A robot may not harm humanity or, by inaction, allow humanity to come to harm.

This clearly marks the relevance of debating issues such as the ubiquitous deployment of robots in future society; their use in home and care contexts; the implications of developing autonomous weapons systems and autonomous cars; or, giving it a seemingly positive touch, the development of robots for attachment, love, or sex.

Figure 11.3 Isaac Asimov (January 2, 1920–April 6, 1992).

These days, many robotics research projects envision robots as "slaves," in the sense that they conduct acts on behalf of humans, like killing others or serving to fulfill humans' need for psychological closeness and sexuality. Some of these projects are even funded by government agencies. At the same time, there are clear countermovements, such as the Campaign Against Killer Robots.[3] As responsible researchers, we have to consider the ethical implications of what we envision and the steps we take to approach these visions of the future (Sparrow, 2011). In the following subsections, we discuss some of the common topics of ethical concern in HRI research.

11.2.1 Robots in research

As a student beginning to get hands-on experience with empirical research in HRI, you might plan to conduct a study with a robot that acts seemingly autonomously. Even here, ethics has to be considered because you might choose to deceive your participants by controlling your robot using the Wizard-of-Oz approach. You thereby make the participants believe that the robot has certain functions, whereas in reality, you control the robot's behavior in the background. The problem with this approach is that the deception concerning robot skills raises and biases users' hopes and expectations about the robot's abilities. This may manipulate them into thinking that robotic technology is more advanced than it actually is (Riek, 2012).

Another critical example to consider might be the usage of robots as persuasive communicators within your research project. Previous research on persuasive technology has shown that robots can be used to manipulate people into changing not only their attitudes but also their behaviors (Brandstetter et al., 2017). Examples of behaviors that have been successfully influenced include health-related habits, such as exercising or maintaining a healthy diet (Kiesler et al., 2008). Even if it might benefit people to change their health-related habits, such as smoking less and exercising more, instrumentalizing social robots for

[3] `https://www.stopkillerrobots.org/`

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this purpose poses ethical concerns if they exploit the social bond with the user and influence the user without the user's explicit consent and conscious knowledge or understanding about how he or she is being influenced.

11.2.2 Robots to fulfill emotional needs

Robotic care

Imagine your grandmother has been given a robot companion by a group of researchers. They tell her that this new technological friend will stay with her in her home for the next three weeks. She interacts with the robot every day for these three weeks, and over time, she becomes quite attached to it. The robot invites her to do activities like memory games on a regular basis. It asks her how she is doing and whether she slept well; it keeps her company, and it never argues with her. She is delighted with her new companion, and life is good. That is, until the researchers come back and ask her to complete some questionnaires before packing up the robot and taking it away. The dull routine of the elderly care center creeps back, and she feels even more lonely than before.

This brief scenario gives a glimpse of the psychological experience of getting attached—not only to people but also to objects like robots. HRI researchers have shown how easily people grow attached to a robot, even when it only briefly enters their everyday lives (Šabanović et al., 2014; Forlizzi and DiSalvo, 2006; Chang and Šabanović, 2015; Kidd and Breazeal, 2008). The emotional and social consequences of withdrawing this source of attention and "artificial affection" clearly need to be considered when running case studies with a social robot that has to be returned at the end of the study.

Other studies, however, have demonstrated the beneficial effect of deploying small-scale robots such as the therapeutic robot Paro (Wada and Shibata, 2007; Shibata, 2012) or the robot dog Aibo (Broekens et al., 2009). These robots are not able to do any tedious manual labor, but they can provide companionship. Given the high workload that caretakers are burdened with, any relief, even small, is likely welcomed.

Sparrow and Sparrow (2006) offer an interesting perspective on robotic care that has become a classic in the literature. They argue that even when a robotic caregiver could be developed that is capable of providing superb emotional and physical care, it would still be unethical to outsource care to machines. The reason for this is that a relationship can only be meaningful when it is between two entities that are capable of experiencing reciprocal affect and concern; an imitation of caring, however perfect, should never substitute the real product. This kind of relationship may also be detrimental to the value of upholding

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a person's dignity. This brings us into the ethics of developing a deeper emotional attachment to a robot.

Emotional attachment to robots

Affection toward robots can go deeper and beyond the care setting. Humans may start to favor robot companions over humans. Imagine a social robot that can truly mimic friendship and emotional support. This "ideal robotic friend" comes with all the perks of a human friend, never complains, and learns never to annoy its owner. Slowly, people could come to prefer these robotic companions over their human peers, who would not be able to measure up to the high standards that robotic friends provide. Would such a future be desirable?

Even though users may project all kinds of human traits into a robot, the robot is not able to experience those traits in the same way humans do, and therefore, the authenticity of the expression can be doubted. Still, robots are sometimes specifically designed to express social cues to deliberately facilitate bonding with them. The authenticity of feelings is normally important in human–human interaction, and we do not know how humans will react to robots that express themselves based on calculations rather than the sensation of emotions.

Going beyond human–robot friendship, there are individuals who feel closeness and intimacy toward robots. The broader question is whether promoting human–robot emotional bonds is desirable (Borenstein and Arkin, 2016). After all, we have to realize that the emotional relationship between humans and robots might be asymmetrical. Humans might nevertheless be quite satisfied with the robot exhibiting sympathetic responses, whether the robot has a humanlike sensation of attachment or not.

Ethical implications of persuasion through robots

Language develops dynamically, and every participant in discourse influences its development simply through its usage. New words appear (e.g., "to google"), others change their meaning (e.g., "gay"), and yet other words fall out of usage altogether. We can use Siri, Cortana, or Bixby to control our phones, homes, or shopping tours. Familiarity alone will influence our attitudes toward concepts, political ideas, and products; this is called the "mere exposure effect" (Zajonc, 1968). The more often people hear a word, the more positive their attitude toward this word becomes. One day, it will make a great difference if your smart-shopping robot proposes to purchase "Pepsi" compared to offering a "Coca-Cola." The question really is who gets to decide what words our artificial counterparts use.

Robots have the ability to synchronize their vocabulary through the internet in seconds. Even the mass media cannot compete with this level of consistent usage of selected words (Brandstetter et al., 2017).

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Because of its ability to communicate in humanlike ways, a robot can be a convincing persuasive communicator. This comes with negative implications, though: without us even noticing, computers and robots can influence what words we use and how we feel about them. This can and probably is happening already, and we need to develop media and language competency to be able to withstand attempts to influence our views. With the ever-more personalized and intimate relationships that we form with technologies, we are increasingly vulnerable. We probably already spend more time with our phones than with our partners and friends.

Furthermore, to our knowledge, there are no regulations or policies in place at this point in time to supervise how large information technology (IT) companies, such as Google, Amazon, or Facebook, influence the usage of language, although there is concern about "fake news" and the difficulty of telling fact from fiction in online contexts. It might also be a better approach to regulate the development of our language only to the degree that it should be left to its natural flow of change. With powerful tools at our fingertips, we need to ensure that no company or government can influence our language without our consent and that the robots we design do not become just one additional persuasive and misleading technology.

Generalizing abusive behavior toward robots

Being recognized as a social actor comes with a downside: not all social behaviors are positive. In a few field experiments with autonomous robots that were left unsupervised in public spaces, people were observed attempting to intimidate and bully robots (Brscić et al., 2015; Salvini et al., 2010). It is noteworthy that the type of aggression that people displayed seemed to resemble human–human abuse, such as kicking, slapping, insulting, and refusing to move out of the way after the robot politely asked. Abuse that would be more meaningful for machines, such as unplugging them or cutting their wires, was not observed.

Robots normally do not experience any pain or humiliation, and hence the human actually faces greater danger than the robot when, for example, slapping the robot because the human might hurt his or her hand. But there are more issues to consider than just the bully's bodily integrity. It has been argued that bullying a robot is a moral offense—even though nobody gets hurt, responding with violence is still considered wrong and should therefore be discouraged (Whitby, 2008). In addition, scholars have argued that if this behavior is perceived as acceptable, it might generalize to other social agents, such as animals and humans (Whitby, 2008; De Angeli, 2009). This transfer of negative behavior from a humanlike agent to actual humans is argued to also happen in other domains, such as violent computer games (Sparrow,

2017; Darling, 2012), and has been a topic of discussion for quite a while. Further research on this topic is still needed.

A related issue is that interactions with a robot may raise expectations regarding the behavior of other humans. This has been argued to be particularly dangerous in the domain of sex. A robot could easily be designed to seem to desire intercourse at any time and to readily and fully comply with any wishes of the user without having any desires or demands of its own. This could change what people consider normal or appropriate behavior from an intimate partner.

This issue becomes even more problematic if the robot is specifically designed for sexual behaviors that would be considered wrong if it had involved human partners. For example, child-shaped sex robots could be designed to fit the desires of pedophiles; or sex robots could be programmed to explicitly not consent to or even struggle against sex in order for users to play out their rape fantasies. These robot behavior designs have been deemed ethically inappropriate by some scholars (for a philosophical justification, see Sparrow (2017)).

11.2.3 Robots in the workplace

A repeatedly expressed worry is that "robots will take over" and "robots will replace me in the job market." Since the Industrial Revolution, humans have been replacing manual labor with machines, and the recent deployment of robots is no exception. Robots help us to improve our productivity and thereby help to increase our standard of living. Although robots do replace certain jobs, they also create many new jobs, in particular for highly trained professionals. The challenge that society is facing is that the people replaced by robots need to find new jobs, which might require them to embark in additional training or studies. This may be problematic or even impossible for some, for example, due to financial or intellectual constraints.

Some fields, such as education, are less welcoming toward accepting robots in their workforce. Reich-Stiebert and Eyssel (2015) showed that robots are preferred as assistants in the classroom but not as the main teachers. They also voiced concern about the usage and maintenance of the robots, being particularly fearful that the robot would take their resources in terms of time and attention. Interestingly, primary school teachers were particularly reluctant to have robots in schools, maybe because in their view, young students are particularly vulnerable. An analysis of the predictors of such rather negative attitudes and behavioral inclinations toward educational robots revealed that technology commitment was the key predictor of positive attitudes. That is, those teachers who were open to working with novel technologies in general felt more positive about robots and the future use of them in their classrooms. Another field in which people are concerned about the ap-

plication of robots is assistive robots in their homes (Reich-Stiebert and Eyssel, 2015, 2013). Again, technology commitment was found to predict people's reluctance to accept robots in their lives.

Haegele (2016) claimed that more and more robots will be sold on the market in the next few years. Their acceptance into society, however, will remain a challenge, and further research on technology-related attitudes and how to change them is necessary to increase society's acceptance of robots.

11.3 Conclusion

It is important to realize that robots, humans, and their interactions are part of broader societies that encompass different kinds of people, technologies, institutions, and practices. In these different social and cultural contexts, people may hold different initial attitudes and beliefs about robots based on their prior exposure to fictional narratives and popular media. Potential users of robots will also hold different social and cultural values and norms. Both these cultural narratives and values will affect how people perceive and respond to robots and how the use of robots might affect existing social structures and practices. HRI researchers should be conscious of and sensitive to prevailing cultural narratives and values when they design and deploy robots in society, and they should also consider whether they want robots to reproduce or challenge existing practices and norms.

Questions for you to think about:

- What was the last movie or series you watched, or book you read, that depicted robots?
- List the characteristics of the robot protagonists you have recently seen in a film or TV series. What were their capabilities? Did they appear humanlike? Did they pose a threat to humanity, or did they save the world?
- How will the availability of new forms of media such as YouTube change people's expectations toward robots?
- Think of professions that have been replaced by machines. Which ones come to mind? What are the potential positive and negative implications of this replacement?
- Is there an activity that you are happy to have a machine do? What is an activity that you would not want to be replaced by a machine? How do you think others might feel about your choices—who might disagree?
- Discuss whether it is ethical to use a social robot as comfort for

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lonely elderly people. Describe relevant issues, and explain your opinion.
- In a future where highly intelligent robots are available, would it be ethical to develop robot nannies or robot teachers? Describe the potential issues.
- Some HRI studies are provocative or thought-provoking, for example, Bartneck et al. (2018) on the presence of racism in HRI. Is it ethical to run controversial HRI studies? Are there particular themes, such as religion, where HRI should not tread?

Future reading:

- Spike Jonze. *Her*, 2013. URL `https://www.imdb.com/title/tt1798709/?ref_=fn_al_tt_1`
- Isaac Asimov. *The Robot Series*. 1950–1986. [this collection consists of several books that were never formally published as a series]
- Philip K. Dick. *Do androids dream of electric sheep?* Boom! Studios, a division of Boom Entertainment, Los Angeles, CA, 1986. ISBN 978-160886784. URL `http://www.worldcat.org/oclc/929049302`
- Jake Schreier. Robot and Frank, 2013. URL `https://www.imdb.com/title/tt1990314/`
- Amanda J. C. Sharkey. Should we welcome robot teachers? *Ethics and Information Technology*, 18(4):283–297, 2016. doi: 10.1007/s10676-016-9387-z. URL `https://doi.org/10.1007/s10676-016-9387-z`
- Peter W. Singer. *Wired for war: The robotics revolution and conflict in the twenty-first century*. Penguin, New York, NY, 2009. ISBN 9781594201981. URL `http://www.worldcat.org/oclc/857636246`
- Gianmarco Veruggio, Fiorella Operto, and George Bekey. Roboethics: Social and ethical implications. In Bruno Siciliano and Oussama Khatib, editors, *Springer handbook of robotics*, pages 2135–2160. Springer, 2016. ISBN 978-3-319-32550-7. doi: 10.1007/978-3-319-32552-1. URL `https://doi.org/10.1007/978-3-319-32552-1`
- Edmond Awad, Sohan Dsouza, Richard Kim, Jonathan Schulz, Joseph Henrich, Azim Shariff, Jean-François Bonnefon, and Iyad Rahwan. The moral machine experiment. *Nature*, 2018. ISSN 1476-4687. doi: 10.1038/s41586-018-0637-6. URL `https://doi.org/10.1038/s41586-018-0637-6`
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