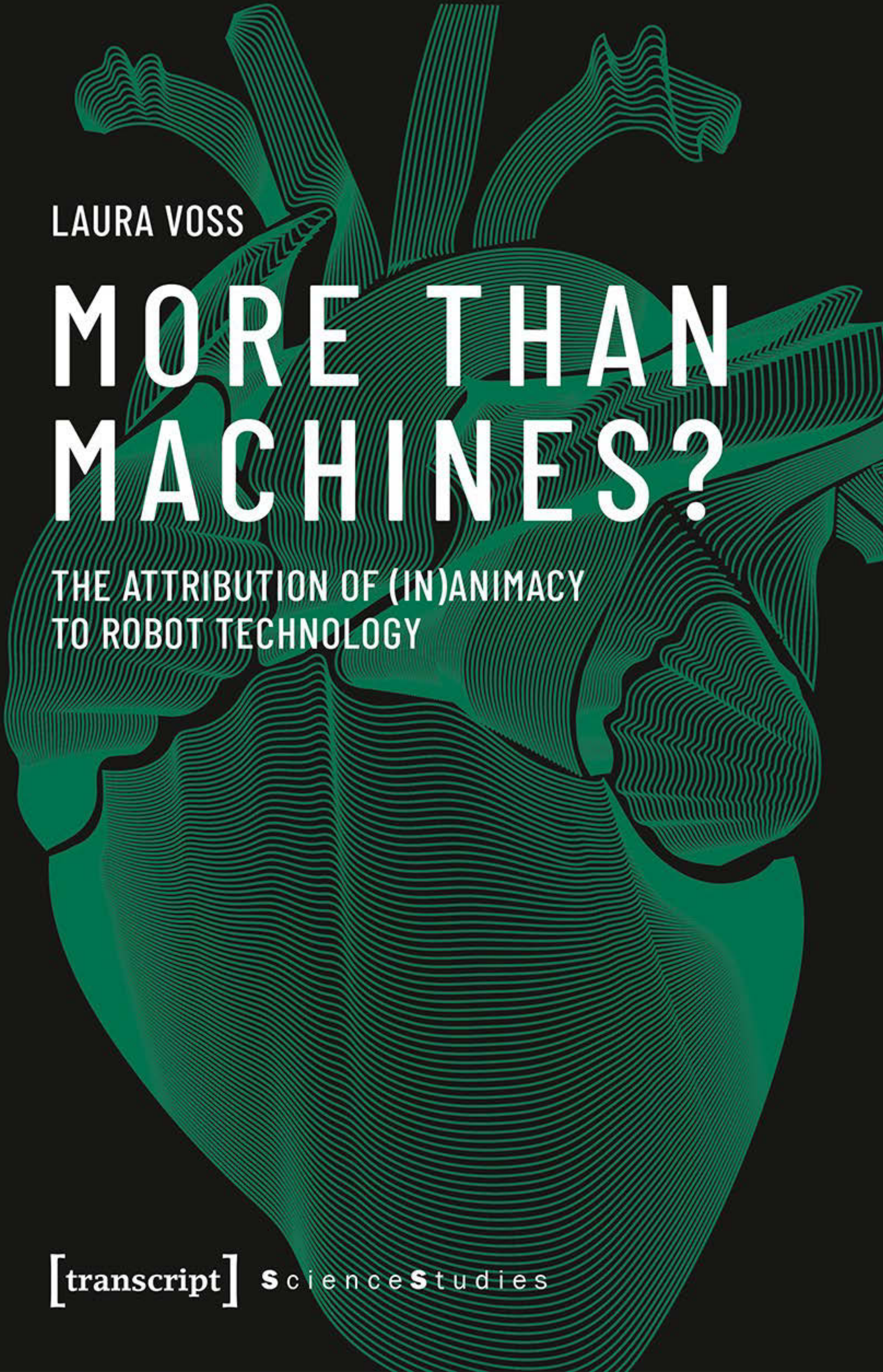
LAURA VOSS

MORE THAN MACHINES?

THE ATTRIBUTION OF (IN)ANIMACY TO ROBOT TECHNOLOGY



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Laura Voss
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The Attribution of (In)Animacy to Robot Technology

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We know that robots are just machines. Why then do we often talk about them as if they were alive? Laura Voss explores this fascinating phenomenon, providing a rich insight into practices of animacy (and inanimacy) attribution to robot technology: from science-fiction to robotics R&D, from science communication to media discourse, and from the theoretical perspectives of STS to the cognitive sciences. Taking an interdisciplinary perspective, and backed by a wealth of empirical material, Voss shows how scientists, engineers, journalists – and everyone else – can face the challenge of robot technology appearing »a little bit alive« with a reflexive and yet pragmatic stance.

Laura Voss is a science manager in the Research Strategy Unit of Ludwig-Maximilians-Universität München. With a background in neuro-cognitive, organizational, and occupational psychology, she previously worked as a science and technology studies researcher and as a science manager at the Munich Center for Technology in Society (MCTS) and for international robotics R&D consortiums at the Technische Universität München.

For further information:

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Preface

2400 years ago

> *"The King looked at it in amazement; it was striding quickly looking up and down; undoubtedly it was a man. When the craftsman pushed its cheek it sang in tune; when he clasped its hand it danced in time; it did innumerable tricks, whatever it pleased you to ask. The King thought it really was a man."* (Lièzǐ, 列子, ca. 400 B.C.)[1]

Today

> *"It's a pile of aluminum and copper wire and software. I don't cheer for my laptop. But people cheer for these [robots]. And of course when it falls, we all feel terrible, 'Uh, it got hurt.' But at the end of the day … It's just a machine."* (Gill Pratt, then program manager of the US Defense Advanced Research Projects Agency (DARPA), discussing robots competing at the DARPA Robotics Challenge, 2015)[2]

> *"I know it's a machine. [But] there was just something about it. It was more reliable than the other ones. … I just had some connection to it."* (US Air Force Colonel Stephen Jones describing a RQ-1 Predator remotely piloted aircraft)[3]

1 Cited in Richey, 2012, p. 194.
2 Cited in Guizzo & Ackerman, 2015.
3 Cited in Pawlyk, 2019.

> "*Me, a scientist, not easily fooled. Also me: why are you sad, Cozmo?* 💔" (Anna Henschel, a PhD candidate in Psychology and Human-Robot Interaction, commenting on a Cozmo toy robot in a Twitter post, 2019)[4]

> "*We got a Roomba and I get it now … I would die for this hardworking little man.*" (Ryan Boyd, a computer scientist, commenting on a vacuum cleaning robot in a Twitter post, 2019)[5]

4 https://twitter.com/annahenschel/status/1197561427994828800 (accessed 2019-12-02).

5 https://twitter.com/ryandroyd/status/1103782256638812161 (accessed 2019-03-08).

1. Robots Wanted – Dead And/Or Alive

1.1. Making Love and Killing People: The Old and New Age of Robotics

Robots have the connotation of a futuristic technology. In fact, however, they have been around for quite a while: Simple self-operating machines, so-called automata, existed already in ancient Greece, and the manufacturing tradition continued on into medieval times (Truitt, 2015). In the fifteenth century, Leonardo da Vinci drew plans for a humanoid robot (Moran, 2006), and in the eighteenth century Jacques de Vaucanson built his legendary mechanical defecating duck (Riskin, 2003). These automata were mostly toys or pieces of art, bespoke single pieces made not to take on work, but to entertain, to be admired, or to serve as proof for a mechanical concept. Only in the twentieth century had the state of the art, in what was now called robot technology, progressed far enough to be applied on a larger, commercial scale. From the first moving assembly line in a Ford factory in the early twentieth century (Ford.com, n.d.) it was a short way to fully autonomous robots. The earliest concepts for industrial robots emerged in the 1930s. In 1960, the first programmable digital robot was introduced. The 1970s spawned not only the first robotic production lines, but also the first real humanoid robots. Since the early twenty-first century, there even are robots in space and on Mars.

In recent years, robots have been making another important step. They have made their way out of their factory cages and out of robotics laboratories, entering private homes and public spheres to be employed in close physical and social proximity to humans. Today, robotics is a global industry with a 50-billion-dollar turnover. In 2019, 17 million household service robots and 400,000 industrial robots were sold – in addition to the two million already in use (IFR, 2019; Siciliano & Khatib, 2016).

Until recently, the vast majority of robots was employed in the manufacturing industry, and confined to factory cages. They were simply too "dumb" and inflexible, and therefore too dangerous for humans to be around. Since the 2010s, this has begun to change drastically, heralding a "New Age of Robotics" (e.g. Hessman, 2013; Macdonald, 2013):

> "From a largely dominant industrial focus, robotics is rapidly expanding into human environments … Interacting with, assisting, serving, and exploring with humans, the emerging robots will increasingly touch people and their lives." (Siciliano, 2013, p. v)

This new generation of robots is smaller, lighter, more flexible, more adaptive, and more precise – and much more suited for use in close physical proximity to humans, or even in collaboration with them:

> "New robotics no longer concerns only factory applications, but also the use of robotics in a more complex and unstructured outside world, that is, the automation of numerous human activities, such as caring for the sick, driving a car, making love, and killing people." (Royakkers & Est, 2015, p. 549)

Coming in the shape of small mobile platforms, lightweight manipulators ("robot arms") or even with a design inspired by the human body (humanoid robots), a variety of these new robot models are available on the market today, and many more are being developed in academic and commercial robotics labs around the world. Small logistics robots operate in close proximity to humans, for example in Amazon's warehouses[1] (Simon, 2019). Domestic robots like mops, lawn mowers, and vacuum cleaners – such as the popular Roomba[2] – are a huge market success (Tobe, 2014, 2017). Remote controlled mobile platforms with manipulators have become standard equipment in law enforcement and the armed forces, and are routinely deployed in search and rescue operations, explosive ordnance disposal (EOD), and even combat missions (Nosengo, 2019). Collaborative robots ("cobots"), such as Universal Robots'[3] and Kuka's[4] lightweight arms or Rethink Robotics' "Sawyer"[5], are increasingly employed in a range of commercial contexts.

1 http://www.amazonrobotics.com (accessed 2019-10-25).
2 http://www.irobot.com/roomba (accessed 2019-10-25).
3 https://www.universal-robots.com/products (accessed 2019-10-25).
4 https://www.kuka.com/en-de/products/robot-systems/industrial-robots/lbr-iiwa (accessed 2019-10-25).
5 https://www.rethinkrobotics.com/sawyer (accessed 2019-10-25).

Dead And/Or Alive?

This new kind of robot and this new form of interaction with robots appear to touch a nerve in the human mind. We have always been fascinated with objects we know to be inanimate but which, for some reason, appear animate to us. For most of human history, these objects were largely restricted to the world of fiction. Robot technology pulls them into the real world, and into our immediate physical and social environment.

Robots have a range of characteristics causing us to associate them with living beings: They are embodied entities in our vicinity, they act autonomously and unpredictably, they sense and react to their environment, they can be mobile and interactive. Crucially, this association is – at least in most cases – not founded in a false belief that robots are actual living beings. It is present in spite of our knowledge that robots are, in fact, inanimate objects. Robots, it appears, can be perceived as both inanimate and animate at the same time.

There is a plethora of both anecdotes and scientific research showing that humans can attribute various lifelike characteristics to robots, and that this influences their attitudes and behavior towards the robots. The field of human-robot interaction studies (HRI) has been producing a vast number of studies trying to explain and quantify the conditions and circumstances of this phenomenon (some of which we will explore in Chapter 2). They usually do so by "measuring" how different characteristics of a human and a robot influence how the human perceives and behaves towards the robot. However, most of this research only explores human reactions to a very specific kind of robot assumed to trigger the strongest attributions of animacy[6]: humanoid robots and robots with an animal-inspired design[7]. This stands in contrast to those robots already in use outside of factories and robotics laboratories today, most of which do not have a humanoid or animal-inspired design.

Most of this HRI research is not conducted in the field, but instead under somewhat artificial laboratory conditions. After all, the few robots that have already made it out "in the field", those that are available for purchase for the average consumer, do not appear to belong to the fascinating group of interactive "new robots". The popular vacuum cleaner robots, for example,

6 Chapter 2, Section 2.2, will explain why this book uses the term "animacy" and not, for example "aliveness", "agency" or "intentionality".

7 Sometimes called "zoomorphic robots".

are nothing more than a small disc shaped vehicle driving across the floor, occasionally bumping into a table leg. The simple shape does not keep humans from developing deep social and emotional connections to them, however, not even from attributing animacy or a personality to them (e.g. Sung, Guo, Grinter, & Christensen, 2007; Forlizzi & DiSalvo, 2006; Forlizzi, 2007; Sung et al., 2008; J. Fink, Mubin, Kaplan, & Dillenbourg, 2012). In fact, many users appear to perceive their vacuum cleaner robots as an entity "sit[ting] somewhere between a pet and a home appliance" (Sung et al., 2007, p. 7). There are reports of customers who "t[ook] them on holiday, unwilling to leave them at home alone" (Kahney, 2003).

> They "express[ed] concern when … told … to mail in their Roomba and receive a new one in return… they didn't want a new vacuum. … They wanted 'Rosie' to be … healed." (Sitrin, 2016)

> "There are people who actually consider them their companion, even though it's just vacuuming their floor … People get attached to them and think of them as part of their family. It's almost a pet. It makes them feel like they're not alone." (iRobot spokeswoman Nancy Dussault, cited in Kahney, 2003)

These emotional reactions were not intended by the robots' manufacturers. They were, in fact, surprised by their customers' dedication to the little cleaners:

> "When iRobot created Roomba, we didn't want it to be cute; we wanted people to take it seriously, so we gave it more of an industrial look. 25M home robots later, people still personify their Roomba. Over 80% name their robot and many consider it part of the family." (Colin Angle, CEO and founder of iRobot, 2019)

Cute little household helpers are not the only robots with a surprisingly emotional connection to their users. Robots used by bomb squads for explosive ordnance disposal (EOD) are basically small remote controlled tanks with a grasping device on top. And yet they are perceived by their human operators as more than just a tool. These robots are sometimes even considered to be team members, deserving of a funeral when they get "killed" (e.g. Garreau, 2007; P. W. Singer, 2009; J. Carpenter, 2013; Pawlyk, 2019).

> "Sometimes [the soldiers] get a little emotional over it … Like having a pet dog. It attacks the [bombs], comes back, and attacks again. It becomes part

> of the team, gets a name. They get upset when anything happens to one of the team. They identify with the little robot quickly. They count on it a lot in a mission. The bots even show elements of "personality" … Every robot has its own little quirks." (Bogosh, cited in Garreau, 2007)

The list of anecdotes goes on: People have been reported to attribute animacy to robotic ottomans (Sirkin et al., 2015), robotic trash cans (Yang et al., 2015), and planetary rovers (e.g. Clancey, 2006; Feltman, 2014; L. Wright, 2016).

That humans can develop emotional connections to technological artifacts is not a new finding per se. It has already been observed with, for example, cars (Chandler & Schwarz, 2010) or mobile phones (Jane Vincent, 2005). The case of robots, however, is unique in that it sparks a new discussion about the ontological status of technological artifacts. In all of the examples explored above, people are very well aware that robots are inanimate objects. Nonetheless, something about robots makes them appear to be more than "just machines".

The question of what robots are, ontologically, has sparked a lively discussion across public and academic discourses. Scholars across disciplines have described robots as "neither alive nor not alive" (Severson & Carlson, 2010, p. 1101), "neither and both" (Melson et al., 2009, p. 563), "alive in some respects and not alive in other respects" (Kahn et al., 2004, p. 549), "both animate and inanimate" (De Graaf, 2016, p. 592), "sort of alive" (Turkle et al., 2004, p. 4), "stand[ing] between an 'animal kind of alive' and a 'human kind of alive'" (ibid., p. 11), or "simultaneously enacted as an agent and as a thing" (Alač, 2016, p. 526). Other authors described robot users as showing "a 'weird' doubleminded attitude" (Bruckenberger et al., 2013, p. 305) or as holding "parallel conceptions" of robots (Fussell et al., 2008, p. 151).

It appears to be quite difficult to sort robots in a dichotomy of "animate" and "inanimate". Some scholars even propose to create an altogether new, different ontological category for them:

> "If from the person's experience of the subject-object interaction, the object is alive in some respects and not alive in other respects, [it] is experienced not simply as a combination of such qualities … but as a novel entity." (Kahn et al., 2004, p. 549; cf. Severson & Carlson, 2010)

1.2. Hype, Hope, and Horror

While the scholarly discussion on the ontological status of robots is going on in academic journals and conference halls, the machines in question are already making their mark on our everyday lives. Almost every day the news report on yet another revolutionary robot technology being "unleashed" on society. It seems that, finally, all the robots we so far only knew from science fiction are becoming reality – as are the scenarios associated with them, both the hopeful and the scary ones.

The current hype around robot technology is thoroughly embedded in – and fueled by – culturally shared visions and imaginaries of a robot-populated future. Crucially, these visions cannot only be encountered in popular culture, in science fiction movies, shows, and novels. They are very much a part of our "real life", in that they shape the way robot technology is discussed by laypeople, by the media, and by policy makers.

The notion of visions of the future crucially shaping the development of emerging technologies has been of interest for science and technology studies (STS), sociology, and innovation studies. Concepts like guiding visions (German "Leitbilder"; cf. e.g. Giesel, 2007), expectations (e.g. Borup et al., 2006; Beckert, 2016; Brown et al. 2000), socio-technical imaginaries (e.g. Jasanoff & Kim, 2009, 2015), or socio-technical futures (e.g. Böhle & Bopp, 2013) describe how imaginations of the future shape the development of technology in the present. These different approaches all share the idea that visions of the future have a guiding and structuring function. By drawing the focus on a shared horizon and "[preparing] possibilities of future events" (Luhmann, 1988, p. 121), they reduce the complexity of possible paths into the future. They help to define roles and tasks, and to legitimize and coordinate science and governance efforts, such as resource allocation and legislation (Borup et al., 2006; Giesel, 2007).

These functions can also be observed for the case of robot technology. Visions for a robotized society can be found in policy documents across the world. In the European context, there is the EUROP[8] Strategic Research Agenda, with elaborate "Product Visions & Application Scenarios" (EUROP, 2006, 2009), or the SPARC[9] Strategic Research Agenda, featuring short stories on desirable robot applications (SPARC, 2013). There is Japan's New Robot

8 European Robotics Platform (http://www.robotics-platform.eu).
9 "The Partnership for Robotics in Europe" (https://www.eu-robotics.net/sparc).

Strategy (The Headquarters for Japan's Economic Revitalization, 2015), the Korean Robot Act (cf. S. Kim, 2018), and the US National Robotics Roadmap (Computing Community Consortium, 2016a). They all lay out visions for futures in which robot technology is employed in almost all possible contexts – from health care to education, from manufacturing to transportation.

While these documents are mostly geared towards policy makers, other – more extreme – imaginations draw much public attention. With robotics being "an emerging and significant area of controversial technoscientific development" (Wilkinson, Bultitude, & Dawson, 2011, p. 373), public discourse appears to be split between two contrasting narrative poles. At one end of the spectrum, we can observe a discourse steeped with utopian techno-optimism, promising solutions to a score of societal problems. At the other end, there is a dystopian-pessimistic discourse, dominated by a view of robots as competition for humanity, by fears of humanity being replaced or subjugated by ultra-intelligent and powerful "robot overlords". Both of these discursive extremes are heavily influenced by popular science fiction tropes (cf. COMEST, 2017, p. 40; Gesellschaft für Informatik, 2019), which we will explore in more detail in Section 1.3.

The impression left by this discourse, that robot technology is getting "closer to science fiction", is in fact not completely unfounded. Most of the robot characters we know from popular science fiction stories are able to act autonomously, interact socially with humans, have roles and tasks traditionally reserved for humans, and often even look like humans. This – as discussed above – is exactly the kind of "New Robots" which have been making their way from robotics laboratories into our everyday lives.

It is also the kind of robot technology that has been showered with political and financial support in the recent past. In the United States, the 2011 National Robotics Initiative (NRI) and its 2016 successor NRI 2.0 dedicated around 100 million dollars of funding "to accelerate the development and use of robots in the United States that work beside or cooperatively with people" (Jahanian, 2011; National Science Foundation, 2019). Japan's 2015 New Robot Strategy and Robot Revolution Initiative, with service robotics as one of the funding foci, pushed to quadruple the Japanese robotics market to 2.4 billion yen by 2020 (The Headquarters for Japan's Economic Revitalization, 2015; Edwards, 2015). The European Commission poured 700 million Euros into SPARC, "the largest civilian robotics research and innovation programme in the world" (EU Robotics, 2018). This funding boost is part of a global robotics "arms race", fueled by a political and economic discourse that constructs robot technology as inherently useful (Bischof, 2017a, p. 138). As Andreas Bischof notes, research and development in these initiatives is often driven by a goal of finding problems to which to apply robot technology – rather than the goal of finding robot-assisted solutions to existing practical problems (2015, pp. 156 & 181). The idea of an inevitable future brimming with robot technology seems to serve as a self-fulfilling prophecy (cf. Meister, 2011, p. 120).

The underlying assumption of usefulness, hope, and even salvation through robots is also observable at the "utopian extreme" of public discourse. Here, robots are presented as a universal solution for some of today's most pressing issues. Most prominently among those issues: the "alarmist demography" alerting to an aging society in an overpopulated world (Katz, 1992), but also environmental and health crises, unemployment, armed conflict, and more. Robot technology is praised as a "new solution … to societal challenges from aging to health, smart transport, security, energy and environment" (European Commission, 2015), with "the potential to transform lives and work practices, raise efficiency and safety levels, provide enhanced levels of service and create jobs" (SPARC, 2013, p. 6). In this, robots are understood to "represent the dawn of a new era, ubiquitous helpers improving competitiveness and our quality of life" (SPARC, 2013, p. 15). Robot technology is almost hailed as a panacea:

> "Robots can save lives and reduce the economic consequences of disasters … Home health care, mobility, wellness and well-being are being positively impacted by assistive robotics, human-robot interaction, advanced prosthetics, and smart sensing … Robotics can be seen as a tool for not just enhancing but potentially revolutionizing K-12 STEM education … low[ering] the digital divide, and bring[ing] more gender and ethnic balance to the STEM workforce. … Social robots can boost the confidence and self-esteem of children from all socio-economic backgrounds." (Report on US robotics development during the National Robotics Initiative, Computing Community Consortium, 2016b, p. 4)

Across the whole spectrum of discourse, from the pessimistic-dystopian to the hopeful-utopian visions, the increasing application of robot technology in an unspecified future is presented as self-evident and unquestionable. As Andreas Bischof notes, policy documents and public discourse are saturated with a "fatalistic conviction of the unavoidability of a robotic future"[10] (2017a, p. 163), a "teleological inevitability and desirability, inferred from a desire for technical feasibility"[10] (2019; cf. Jasanoff & Kim, 2009). The European Commission and the European Robotics Platform EUROP describe robotized futures as if they were already set in stone, predicting that "as assistants, robots will be co-workers in the workplace, companions at home, servants, playmates, delivering professional services and acting as agents for security" (European Commission, 2008, p. 4), and that "in the service sector robotics coworkers will assist humans performing services useful to the well-being of humans or equipment" (EUROP, 2009, p. 15). Technical and social challenges and obstacles are downplayed, met with counter-arguments, or simply negated. For example, the prominently and controversially discussed issue of technological unemployment – increasing automation potentially making a human workforce obsolete – is quickly settled in a policy document by the European Commission: "While the installation of robots may result in immediate redundancies, the long-term benefits to employment cannot be denied" (European Commission, 2008, p. 1). Other challenges, too, are often swept under the carpet in these and similarly enthusiastic publications: technical bottlenecks like battery capacity, natural language interfaces, or unstructured environments, but also non-technical issues like user acceptance or ethical concerns.

The predominantly utopian policy discourse stands in stark contrast to a much more dystopian, albeit often similarly fatalistic, parallel discourse. Especially in the news media, enthusiastic reports on new robotic technologies are neighbored by predictions of widespread unemployment, of humans being replaced, even of robots "going rogue" and rising as "robot overlords". Also political discourse is peppered with references to this dystopian narrative, especially in the context of autonomous weapons ("killer robots"; e.g. Human Rights Watch, 2014; Sychev, 2018).

This type of controversial and emotional rhetoric can be observed for other emerging technologies as well, which likewise "exist in a state of flux as a mixture of blueprint and hardware, plan and practice, … surrounded by speculation and speculators, who make often-contested claims about their promises, perils, and possibilities" (Hilgartner & Lewenstein, 2014, p. 1). The neighboring discourses on artificial intelligence, machine learning, and neural networks are just as torn between hopes and fears (Marcus, 2013; Cave & Dihal, 2019). The discourse on genetic technology is similarly infused with a "discourse

10 Translated from German by the author

of great promise [and] great concern" (Tambor et al. 2002, p. 35; cf. Durant, Hansen, & Bauer, 1996).

Among the many emerging and controversially discussed technologies robotics has a prominent position, however, as it often is perceived as standing paradigmatically for technological progress. It seems as if robot technology is somehow "always in the future. Every once in a while, a piece of it breaks off and becomes part of the present" (Huggins, cited in Loukides, 2013). In this, robotics is an example of how a strong existing vision of a technological future can also hinder developmental flexibility (cf. Dierkes, 1988, p. 58): "Once technical promises are shared, they demand action, and it appears necessary for technologists to develop them, and for others to support them" (Van Lente & Rip, 1998, p. 17). This makes it possible to misuse robots as a "technofuturistic escape" (Jeon, 2016): Promoting idealized scenarios of a future in which today's pressing problems have been solved by robot technology conveniently gives policy-makers the possibility to evade addressing the current problems.

1.3. Robots and Science Fiction: Inseparably Linked

Robotics' curious status as a technology that is both futuristic and well known to everyone and its prominent discursive position as an unavoidable technology are rooted in the fields' unique history. In robotics, fictional narratives and real technological progress have always advanced hand-in-hand: "No technology has ever been so widely described and explored before its commercial introduction" (Jordan, 2016, p. 5). While technological predecessors of today's robots can be traced back to medieval automata (Truitt, 2015; cf. Section 1.1), the idea of autonomously acting "animated" objects goes back even further, to Greek, Byzantine, and Chinese myths (Brett, 1954; Needham, 1956; "Automatones," n.d.).

This historically close connection of fictional narratives and technological development can be observed in robotics until today. Not only does the word "robot" stem from a 1920 theater play (Čapek, 1920), science fiction narratives also crucially influence roboticists' identity and everyday life culture (Bischof, 2017a, p. 141). They serve as what Susan Leigh Star and James Griesemer (1989) called a "boundary object". Both within the robotics community and in communication efforts by robotics with the general public they provide a shared discursive framework and focus of attention, and they act as a repository for the epistemology of the public discourse on robotics[11]. Even the official website of the IEEE[12], the world's largest association of technical professionals, states that "for most … [roboticists], science fiction has strongly influenced what [they] expect a robot to look like and be able to do" (Guizzo, n.d.). This is also reflected in the many forewords of robotics handbooks written by science fiction authors – such as Isaac Asimov's forewords for Joseph Engelberger's (1980) "Robotics in Practice" and Shimon Nof's (1985) "Handbook of Industrial Robotics"; in the mission statements of commercially successful robotics companies – such as iRobot, which considered the mottos "making science fiction reality" and "practical science fiction" (P. W. Singer, 2009, p. 185); and in countless implicit and explicit references to science fiction as a "hidden curriculum" for robotics (Bischof, 2017a, p. 145; cf. Rammert, 2001, p. 22).

The connection of robotics and science fiction goes so far that policy actors explicitly base legislative decisions on science fiction narratives (Chapter 6 will explore this issue in depth). The most prominent – and controversial – examples are probably the many references to Asimov's (1950) "Three Laws of Robotics"[13] in the discourse on robotics and artificial intelligence (AI) legislation. Even human rights experts, in interviews on the laws of unmanned warfare, have been noted to "reference … Blade Runner[14], the Terminator[15], and Robocop[16] with the same weight as … the Geneva Conventions" (P. W. Singer, 2009, p. 203).

The common practice of understanding science fiction as inspiration, even as a blueprint, for real-life technology development, governance, and legislation faces considerable criticism. Several science fiction writers felt the need to emphasize that their stories are not to be understood as predictions or even recommendations. For example, award-winning science fiction author Ursula K. Le Guin (1976) cautioned:

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11 Hat tip to Lisa Meinecke.

12 Institute of Electrical and Electronics Engineers (https://www.ieee.org).

13 The Three Laws of Robotics: "(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 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 and (0) A robot may not harm humanity, or, by inaction, allow humanity to come to harm" (Asimov, 1950).

14 The film "Blade Runner" (R. Scott, 1982) is based on a short story by Philip K. Dick (1968).

15 The Terminator is the cyborg protagonist of a successful film franchise, starting with "The Terminator" (Cameron, 1984) and comprising six films as of 2019.

16 Robocop is the cyborg protagonist of the film of the same name (Verhoeven, 1987).

> "Science fiction is not predictive; it is descriptive … But our society, being troubled and bewildered, seeking guidance, sometimes puts an entirely mistaken trust in [science fiction authors], using them as prophets and futurologists."

It has been argued that, in fact, science fiction is more concerned with the present than the future. Science fiction author William Gibson pointed out:[17]

> "It's about the present. It's not really about an imagined future. It's a way of trying to come to terms with the awe and terror inspired … by the world in which we live." (cited in Leary, 1989, p. 58)

Understanding science fiction as inspiration for the development of new technologies disregards that most science fiction stories are a way of reflecting on, even criticizing, the past and present reality. As Lisa Meinecke and I noted:

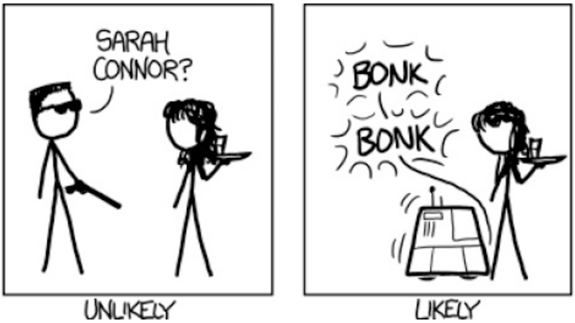
> "[Science fiction] is not a neutral repository of ideas about technology or a roadmap to the future. The narratives are shaped by the cultural context they originate from, by the values, hopes, and anxieties of society. … A fictional robot is rarely just a robot, it is also a narrative canvas for projections of the other, which carries a culture's hopes and anxieties." (Meinecke & Voss, 2018, p. 208)

This reflexive and critical aspect of science fiction appears to go over the heads of many scientists, innovators, and policy makers who seem to understand science fiction as mostly inspirational. A 2018 cartoon commented on science-fiction-inspired expectations of future robots by contrasting an "unlikely" scene from the Terminator movie (Cameron, 1984) with a "likely" alternative concept, in which not the socially interactive cyborg Terminator but a small non-humanoid wheeled platform seeks out the other main protagonist Sarah Connor (see Figure 1).

William Gibson, whose novels often feature an extremely dark and violent technological future, experienced this as well, with "analysts and politicians … actively draw[ing] on [his novels] to justify investment in information and communications technologies" (Kitchin & Kneale, 2001, p. 24). He noted: "The social and political naivete of modern corporate boffins is frightening, they read me and just take bits, all the cute technology, and miss about fifteen levels of irony" (cited ibid.).

17 Specifically referring to his cyberpunk novel "Neuromancer" (1984).

Figure 1: Cartoon "Robot Apocalypse" (XKCD, 2018).



Source: https://what-if.xkcd.com/5 (accessed on 2019-11-26). Image used in accordance with the artist's guidelines (https://xkcd.com/license.html).

In fact, there is "a recursive relationship between scientific every day practice and fictional technology futures" (Bischof, 2017a, p. 145). Not only do fictional narratives influence real-life robotics, many newer science fiction stories reference current developments in robot technology (Meinecke & Voss, 2018, p. 206). This "sci-fi feedback loop" is not unique to robotics but can also be observed, for example, with space flight and defense technologies (Bankston & Finn, 2019).

The process of "science unfiction" (Poon, 2000) goes so far that technology companies and even government agencies hire science fiction writers as consultants. In 2019, the French army announced the creation of a team of science fiction writers, whose task it would be to "propose scenarios of disruption that military strategists may not think of" (BBC News, 2019). Moreover, science fiction films have been shown to feature "diegetic prototypes" of, for example, space ships – providing scientific organizations with promotional images and arguments for the necessity and viability of new space flight technology (Kirby, 2010).

Science fiction narratives not only serve as a boundary object for roboticists themselves, but also for their communication with the lay public (Šabanović, 2007). Due to its immense popularity, science fiction strongly influences most people's ideas of what robots look like and what their capabilities are (Gesellschaft für Informatik, 2019; Bruckenberger et al., 2013). The emotional and controversial public discourse on robotics, as discussed above, reflects this science fiction-fed notion of robots. The discourse is torn between utopian and dystopian conceptions of a robot-populated future, and constantly refers to the recurring themes of robot science fiction: the robot as an "other", and the question what constitutes a human being; robots, androids, and cyborgs as more or less elaborate artificial humans; robots being treated (or not) like humans; robots wanting to become humans; robots standing in competition to humans; robots wanting to overthrow humanity – all these are staples of past and present science fiction literature, TV, and cinema (Meinecke & Voss, 2018). We find these themes in early android stories like Fritz Lang's (1926) "Metropolis", Isaac Asimov's (1950) "Runaround", or Philip K. Dick's (1968) "Do Androids Dream of Electric Sheep?"; in 1980s Hollywood movies like "Blade Runner" (R. Scott, 1982; an adaptation of "Do Androids…"), "The Terminator" (Cameron, 1984), "Robocop" (Verhoeven, 1987), or "Short Circuit" (Badham, 1986); and in movies and TV series of the 2010s, like "Ex Machina" (Garland, 2014), "Big Hero Six" (C. Williams & Hall, 2014), "Chappie" (Blomkamp, 2015), or "Westworld" (Nolan & Joy, 2016). All these stories are expressions of humans' long-standing fascination with stories of "objectively" inanimate machines with characteristics of living beings. With recent developments in the "New Age of Robotics", this fascination is not restricted to the world of fiction anymore (cf. Section 1.1). There are now real robots coming staggeringly close to what, so far, was only known from fiction:

> "Robotics as a technology is fascinating because it represents, even just in the last 20 years, this transition of an idea from something that's always been [relegated to] pop culture to something that's real." (Wilson, cited in LaFrance, 2016)

1.4. Research Question and Approach

The previous sections showed that robot technology – especially the kind of "New Robotics" that is increasingly interactive and employed in close physical and social proximity to humans – is at the center of a controversial discourse spanning fictional narratives, academic research, political decision-making, and public discourse. Robots' polarizing position as either our companions, coworkers, even saviors on the one hand, and as our competition, even potential oppressors on the other hand, is closely tied to their disputed ontological status. Are they "only" inanimate machines? Or are they – somehow – more similar to living beings than other technological artifacts?

This ontological problem, which is so heavily reflected across discourses, also fuels the overarching question (or rather, questions) this book wants to explore. Crucially, this book does not aim to decide what robots "really are", whether robots are like living beings or not, or whether robots should be made to resemble living beings or not. Rather, it will follow an idea voiced by Lucy Suchman, who in her book "Human-Machine Configurations" proposed to

> "[shift the discussion from] whether humans and machines are the same or different to how and when the categories of human or machine become relevant, how relations of sameness or difference between them are enacted on particular occasions, and with what discursive and material consequences." (Suchman, 2007, p. 2)

Inspired by this proposal, we will explore two overarching questions:

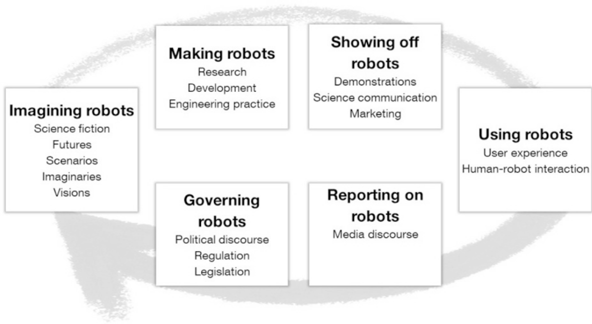
1. **Which discursive and non-discursive manifestations of in/animacy attributions to robots are there?**
2. **What are the conditions, functions, and consequences of these attributions?**

In the spirit of Foucault's (1977) dispositive analysis, we will take apart the complex apparatus of "discourses, institutions, … regulatory decisions, laws, … scientific statements, philosophical, moral and philanthropic propositions" (ibid., p. 194), exploring "the said as much as the unsaid" (ibid.).

This approach is meant to set an explicit contrast to existing research that only looks at a very narrow aspect of robotics – usually that of physical human-robot interaction. We will instead explore the whole "life cycle" of robots, ranging from their conception in fictional and nonfictional visions of a robotized future, to practices of making them physical reality in research and development, to their presentation to different audiences in demonstrations, science communication, and marketing, to users' actual interaction with robots, to the reception of robot technology in the medial and political discourse (see Figure 2).

By following this cycle, we can utilize robot technology as an entry point for the exploration of our present technologized society, in which new technologies fundamentally permeate, and constantly challenge, the lives of individuals, collectives, and organizations. Technologies such as mobile

Figure 2: The "life cycle" of robots.



communication, neurotechnology, or advanced prosthetics, which, in the words of Donna Haraway, "have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines" (1991, p. 152). Robotics is also one of these technologies. Robots can be intelligent, embodied, and autonomous – all characteristics we traditionally know from living beings. They thus challenge traditional views of who and what can be a communicative and socially interactive "other", and appear to scrape, or even break, the boundaries of the social world (cf. Luckmann, 1970; cf. Lindemann, 2005).

1.5. Some Methodological Clarifications

Interdisciplinarity

While guided by the conceptual and methodological traditions of science and technology studies (STS), this book was written with an interdisciplinary mindset. It is aimed at readers of all disciplines and cites relevant literature from a wide range of academic fields. This is not only because the author does not consider herself belonging to one specific discipline: a neuro-cognitive psychologist by training, advised by a sociology of science professor, with professional experience as a researcher and as a science manager, gained at an interdisciplinary research center for science and technology studies and in robotics research and development. It is also also because the issue of what (or who?) robots are – ontologically, culturally, perceptually – is of interest for and researched by a wide range of disciplines, including, but not limited to, science and technology studies, cognitive and evolutionary psychology, communication studies, anthropology, philosophy, and human-machine interaction studies.

Definition of "Robot"

The question of "what a robot is" is difficult to answer – and not only because of robots' unclear ontological status. Even the IEEE provides no official definition of "robot". Its website notes that "the term 'robot' means different things to different people. Even roboticists themselves have different notions about what is or isn't a robot" (Guizzo, n.d.). This issue has become somewhat of a running joke, as the following quotes illustrate:

> "I asked some very smart people a pretty simple question, at least on the surface: 'What is a robot?'. I received answers dripping in ambiguity." (Pearson, 2015)

> "Never ask a roboticist what a robot is. The answer changes too quickly. By the time researchers finish their most recent debate on what is and what isn't a robot, the frontier moves on as whole new interaction technologies are born." (Nourbakhsh, 2013, p. xiv)

> "Ask three different roboticists to define a robot and you'll get three different answers." (Simon, 2017a)

> "I don't know how to define [robot], but I know one when I see one!" (Robotics pioneer Joseph Engelberger, cited in Guizzo, n.d.)

Within the robotics community, opinions differ on whether a robot, in order to be called a robot, has to be mobile (which would exclude stationary robot arms), autonomous (which would exclude remote controlled robots), or interactive (which would exclude many industrial robots). Even the most basic consensus – describing a robot as a machine that can sense, compute, and act in the physical world – is problematic, as this would include seemingly "unrobotic" devices, such as dishwashers and thermostats (Guizzo, n.d.).

In public discourse, even the idea of embodiment is debatable (as Chapter 5 will discuss in depth). On the one hand, many laypeople only think of humanoid robots when they hear "robot", as this is what they know from science fiction. On the other hand, the word "robot" is routinely used in media discourse for non-embodied ("virtual") technologies such as software, AI, and chat bots, or even automation in general (cf. LaFrance, 2016).

For the purpose of this book, the question of which machines are considered robots will be approached like the question of what ontological category robots belong to: Following Lucy Suchman's (2007, p. 2) idea, we will not dwell on which machines "really" are robots, but instead explore when and where the concept of a robot becomes relevant, how it is enacted on particular occasions, and with what discursive and material consequences.

A working definition proposed by Neil Richards and William Smart (2013) closely matches this sentiment:

> "A robot is a constructed system that displays both physical and mental agency, but is not alive in the biological sense. That is to say, a robot is something manufactured that moves about the world, seems to make rational decisions about what to do, and is a machine. It is important to note that the ascription of agency is subjective: the system must only appear to have agency to an external observer to meet our criteria. In addition, our definition excludes wholly software-based artificial intelligences that exert no agency in the physical world. Our definition intentionally leaves open the mechanism that causes the apparent agency. The system can be controlled by clever computer software, or teleoperated by a remote human operator." (Richards & Smart, 2013, p. 5)

On a practical level this means: when a field actor calls something a robot, we will consider it to be a robot.

Cultural Context

Not only is robot technology defined differently in different contexts. The discourse on robotics, their use, and their acceptance in society is also influenced by a vast range of variables. One of these variables is the cultural context. Especially a presumed east-west divide of cultural acceptance of robots has received quite a bit of academic attention. The question of whether eastern cultures are more accepting of robots than western cultures, and whether this has to do with a shintoistic understanding of all objects possessing a spirit[18], is at the focus of interest of a plethora of studies[19]. This book will not explore these cultural differences – as relevant and interesting they are – but explicitly stay on the western side of the presumed divide. The investigated cases are all from the European and North American cultural context. This also means that the insights of this book are not necessarily generalizable to other cultural contexts.

1.6. A Tour Along the Life Cycle of Robots

In the next five chapters, we will go on a journey along the life cycle of robots, exploring a range of different contexts in which robots play a role. In the introductory sections of Chapter 1 we already explored how recent technological developments bring robot technology into closer interaction with humans, and how this raises the question of which ontological category robots belong to, of whether robots can be "animate". We also took a step back to what could be understood as the starting point of a robot's life cycle and explored the fictional and real-life visions that have been crucially influencing technical progress in, as well as public and political discourse on, robotics.

Up next, Chapter 2 will equip us for the further progress of our tour by providing some conceptual tools and disciplinary background. We will untangle the complex terminological, conceptual, and historical context of research on attributions of in/animacy to inanimate objects.

Chapter 3 will continue the tour by diving into the representation of robots as in/animate in the context of robotics research and development.

Chapter 4 will explore how robots are presented as in/animate to different expert and non-expert audiences in the context of robotics demonstrations, science communication, and marketing.

Chapter 5 will examine how robot technology is represented as in/animate in the news media.

18 In contrast to the Judeo-Christian understanding that only God can give life and animated objects are therefore sinful.

19 E.g. Kaplan, 2004; Bartneck, Nomura, Kanda, Suzuki, & Kato, 2005; Geraci, 2006; Kitano, 2007; MacDorman, Vasudevan, & Ho, 2008; Weng, Chen, & Sun, 2009; Tatsuya Nomura, Sugimoto, Syrdal, & Dautenhahn, 2012; Wagner, 2013; Šabanović, 2014; Kamide & Arai, 2017.

The final Chapter 6 will discuss, now from a cross-contextual perspective, the constructive contributions of in/animacy attributions and the critical discourse we will observe across contexts, and provide some take-home messages for the readers of this book.