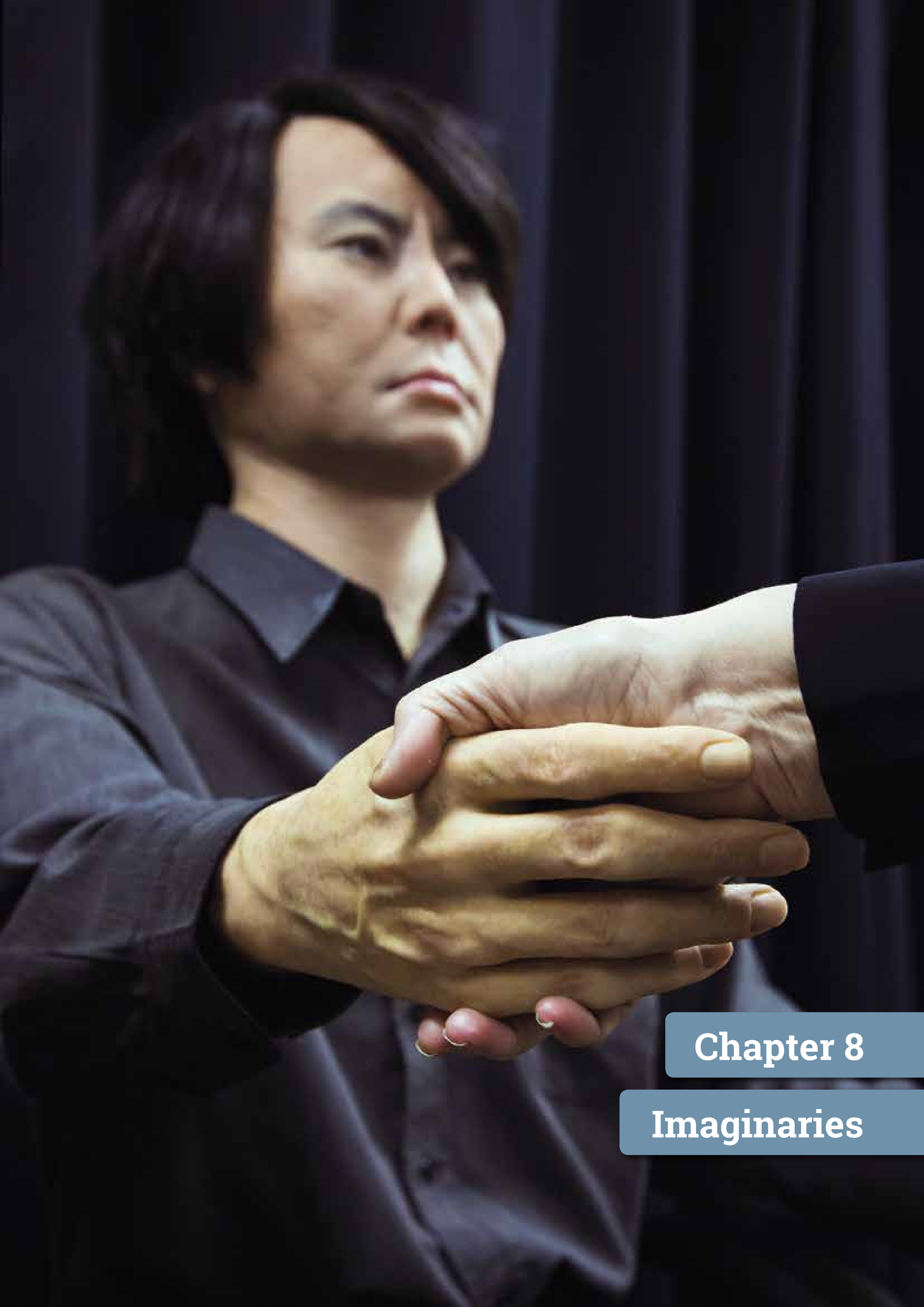

Chapter 8

Imaginaries

Child 1: I don't like robots too much because I have a theory that robots will conquer people.

Interviewer: Will they?

Child 2: It is going to be a rebellion.

Interviewer: Do you think that's possible?

Child 2: Yes.

(Children interviewed about robots, affected stakeholders, ATOM)

◀ Robot imaginaries may spin out of control, when they lose their moorings in materiality.
(Photo by Kate Davis; featuring Geminoid™ HI-2: ATR Hiroshi Ishiguro Laboratories)

8. Imaginaries

Roomba vs. Terminator

You will find here

- An introduction to the concept of imaginaries and examples from public discourse
- Empirical examples of the component part of imaginaries about robots
- Various definitions of a robot
- The role of media

You will acquire

- Awareness of how imaginaries are formed
- Awareness of the role of media and advertising in forming imaginaries
- Awareness that no one definition of a robot exists
- Awareness of how imaginaries influence perceptions of robots

8.1 Introduction

> **Humanoid:** *Entities that are human-like in appearance. E.g. bipedal, stereoscopic vision, opposable thumbs.*

The concept of 'robot' exists in a precarious intersection of public policy, cultural representation, technological innovation, capitalism and philosophy. Yet, no singular definition or understanding of what a robot *is* exists. The same term is used to discuss entities potentially worthy of rights and responsibilities, automatic vacuum cleaners bumping into furniture, or classes of entities ranging from humanoid robot-partners to industrial robot arms. Consequently, the concept may be seen as a moving target, imbued with both interpretations of the current state-of-the-art and visions about the futures.

In this chapter, we present the concept of *imaginary* to help make sense of the debate about the nature of robots, understood as both a concrete materiality and an abstract concept, as it emerges in the REELER data and in public discourse. We argue that robot imaginaries spin out of control, when they lose their moorings in materiality. This we illustrate by comparing robot imaginaries in the public discourse with the robot imaginaries REELER identify among the robot makers, who are well-grounded in the practical work of engineering and thus have a more informed conception of what robots are and can do. We investigate the role of popular media and corporate advertising in shaping robot imaginaries among stakeholders, policymakers, and robot makers, in order to further underline this point.

8.2 What is an imaginary?

The concept of imaginary has a long and varied history, and has been defined in many different ways by different people (e.g. Anderson 1983; Castoriadis 1975; Lacan 1949). In particular, the concept has garnered significant interest within the field of Science and Technology Studies (STS), and has spawned myriads of types of imaginaries (see McNeil 2017 for an overview). In this section, we present some characteristics of an imaginary, without endorsing any particular definition of it.

Briefly, the concept of imaginary comprises *an interpretation* of the present connected with a vision of the future. Following philosopher Kathleen Lennon, we might characterize the first element of the concept as "the affectively laden patterns/images/forms by means of which we experience the world, other people and ourselves" (Lennon 2015, 1). Some of these patterns are historically rooted. For instance, in Japan, some argue that robots are generally conceived of as positive, because the Japanese view robots through the lens of history. This is because the development of robots played a crucial part in the development of the Japanese post-World War II economy, which made Japan one of the biggest economies in the world. In the western world, automation was rolled out under the aegis of Ford and Taylor, which, together with cultural forces, carved out an image of automation in the West as something hostile to human interests (Robertson 2014).

These different cultural interpretations of the fictional robot are reflected in the science fiction writing of the time. American writer Isaac Asimov and Japanese manga artist Tezuka Osamu each crafted laws of robotics governing human-robot interaction long before the technologies were developed to make such interactions possible. "Tezuka and Asimov were socialized in cultural settings differently shaped by World War II and its aftermath, a fact reflected in how they imagined and described the relationship between humans and robots in their literary work" (Robertson 2014, 583). Asimov's laws drew on the threat of a Frankenstein scenario in which the robots turn against their creator, as in Čapek's *R.U.R.* In contrast, Tezuka's addressed "the integration of robots into human (and specifically Japanese) society where they share familial bonds of kinship and perform familial roles" (Robertson 2014, 584). Returning to Robertson's writings *Robot Rights*, the ways in which robots are interpreted and regarded in Japan – in contrast to their reception in Europe and the U.S. – demonstrate how media representations reflect and reproduce our cultural imaginaries. These cultural imaginaries can influence robot makers' notions of robots and their reproductions of notions of the human through robotics (Suchman 2007). It can also affect the affected stakeholders' view of robots, thus making it more difficult for robot developers to get their work accepted. In fact, some robot developers pointed to this very dichotomy when addressing public imaginaries of robots:

> *In every Western movie, the robots are the ones that destroy humanity. In looking at Asian movies, robots are the ones that save humanity. So, it starts from the beginning, childhood comic, that robots are the good and not the bad guys. Yes, we say here [in Europe] that we have neither the technology nor the acceptance.*
>
> (Kai, mechanical engineer and cluster leader, robot developer, COBOT)

These representations and imaginaries can shape our interactions with robots (Suchman 2007), our regulation of robots (Robertson 2014), and the creation of our common life-worlds (Hasse 2015). As we shall see later, the representations of robots within popular media have informed robot imaginaries, preferentially among stakeholders, but also among robot makers.

The other element in the concept of an imaginary consists of a vision of the future. We can think of future societies, where the immense wealth generated by automating large sections of the economy leads to a truly affluent society, where no one wants for anything. The opposite vision also exists; a small elite reaps most of the rewards, while the majority of people can barely scrape by. Depending on our vision of the future, we have, in the present, a way of interpreting the world. Adherents of a positive view of the future might interpret increasing automation as a good thing, since this brings humanity closer to the desired future, and vice versa.

In some classical accounts of the imaginary, e.g. Castoriadis who characterized imaginaries as 'the curvature to every social space' (op.cit. Castoriadis 1987, 143; Strauss 2006, 339), imaginaries are conceptual superstructures shared by an entire social group; for instance, African-Americans in the 1960ies. Like Claudia Strauss, we reject this notion and focus instead on the imaginary as something personal, since ultimately imaginaries can only work, if they are people's imaginaries (Strauss 2006). However, this does not suggest that imaginaries cannot be shared among people, such as among practitioners within a certain field. For instance, Borgmann (2006) refers to an engineering culture. Since the field of robotics includes both the craft of creating robots (the practices) and the robot developers, who are the human engineers, IT-experts, etc. conducting this work (the practitioners), these engaged engineering experts form what Jean Lave and Etienne Wenger (1991) called a 'community of practice', constructing certain understandings through their shared activities. Indeed, robot developers seem to share a more pragmatic approach to robots than the general audience, seeing them as less humanlike and more like pieces of machinery. Yet, as we shall see, there is not one single shared robot imaginary, but rather a patchwork of different elements that make up quite different imaginaries – however, with a weight on robots as material objects. Some are closely linked to AI and machine learning, others to the importance of machines 'doing good' and avoiding harm. For this reason, we find it more productive to discuss a shared **imagination horizon**, a collectively available cultural pool of conceptual resources. One example might be definitions of robots or specific visions of the future, which individuals draw from in forming their imaginaries. Forming an imaginary is not a conscious process of evaluating and picking out the elements most appealing to any particular individual. Rather, it stresses that the horizon can be thought of as a multi-dimensional Rubin's vase, where there are limits to what can be seen even when different individuals see different things.

> **Imagination horizon:** *A collectively available pool of conceptual resources, from which individuals draw out the elements constitutive of a given imaginary.*

To give an example of how all of this comes together, and how clashes between different imaginaries come about, consider the case of military robots. Supporters argue for utilizing autonomous weapon systems in war on the ground of these being superior to humans in precision, efficiency, ability to

The Wizard-of-Oz effect reproduces robot imaginaries inconsistent with robot materialities. (Photos by Kate Davis; featuring Geminoid™ HI-2: ATR Hiroshi Ishiguro Laboratories and Telenoid™: Osaka University and ATR Hiroshi Ishiguro Laboratories) discriminate combatants from non-combatants, and the absence of psychological stressors. As Ronald Arkin of Georgia Institute of Technology puts it:

"Unfortunately, humanity has a rather dismal record in ethical behavior on the battlefield. Potential explanations for the persistence of war crimes include: high friendly losses leading to a tendency to seek revenge … dehumanization of the enemy … pleasure from power or killing or an overwhelming sense of frustration. There is clear room for improvement and autonomous systems may help address some of these problems." (Arkin 2013, 5)

Critics have not denied these potential benefits, but instead they focus on the ethical implications of building robots capable of making decisions about life and death. Some fear an international arms race, and an increased willingness to go to war, since warring countries would 'only' be risking robots – not humans (Russell et al. 2015). Fundamental to this line of argumentation is that robots (and AI) should benefit humanity. As one robot maker puts it in a REELER interview:

> *We don't want the robots to be soldiers, we want the robots to be service robots, helpers.*
>
> (Salome, communications director at a robotics company, robot maker, BUDDY)

What is at stake here is a fundamental split in the imaginaries of the robot. For supporters of autonomous weapons systems, there is a clear-cut argument for using robots in war; they are simply more effective at realizing the goals of warfare. For opponents, using robots for warfare is, however, unethical.

8.3 What is a robot?

In the course of collecting our data material (*see Annex 4*),[1] we found that no single definition of robot was dominant among neither robot makers nor stakeholders. In fact, many robot developers, when asked about a definition of robots, explicitly stated there is no dominant definition of robots.

> *I have absolutely no idea what a robot is.*
>
> (Edgar, system architect, robot developer, SPECTRUS)

1 see responsiblerobotics.eu/annex-4

This finding is consistent with the literature, where several different definitions exist side by side. Some are concerned only with the mechanical configuration of materials; others add conceptual and functional properties also. Not surprisingly, Institute of Electrical and Electronics Engineers (IEEE) stated:

"The term robot may have as many definitions as there are people writing about the subject. This inherent ambiguity in the term might be an issue when specifying an ontology for a broad community. We, however, acknowledge this ambiguity as an intrinsic feature of the domain." (IEEE 2014, 4)

The International Organization for Standardization (ISO) and IEEE offer the following definitions of robots:

"A robot is an actuated mechanism programmable in two or more axes with a degree of autonomy, moving within its environment, to perform intended tasks. Autonomy in this context means the ability to perform intended tasks based on current state and sensing, without human intervention." [2]

"Robot: An agentive device in a broad sense, purposed to act in the physical world in order to accomplish one or more tasks. In some cases, the actions of a robot might be subordinated to actions of other agents, such as software agents (bots) or humans. A robot is composed of suitable mechanical and electronic parts." (IEEE 2015, 5)

These definitions center on a common theme, which we label *materiality and processes*. Here we discuss **robot as materiality**. However, in our data, another perspective consistently turns up in the robot makers' characterizations of what a robot is. This other theme we call *concept and function*. Here we discuss **robot as concept**.

> **Robot as materiality:** *A theme relating narrowly to the technical aspect of a robot, i.e. which material properties (if any) must be present, and which processes much be instantiated for an entity to be a robot.*

> **Robot as concept:** *A theme grouping together phrases that pertain to the conceptual side of a robot.*

To differentiate the two themes, we highlight the sort of questions dealt with under each of these themes. In the following, we briefly characterize the two themes and move on to, firstly, present our main findings in regards to materiality and processes, and secondly in regard to concept and function.

Materiality refers narrowly to the technical aspect of robots, and deals with questions such as: Some make a distinction between a robot as physical (like an automatic vehicle), and robot as pure software (as artificial intelligence (AI) built into

2 ISO-Standard 8373:2012 Robots & robotic devices: https://www.iso.org/obp/ui/#iso:std:iso:8373:ed-2:v1:en

robots). However, even software is in the end composed of materials. So, the question rather becomes what sort of material processes characterize a robot?

It is useful to, and robot makers often do, frame this pair (materiality and processes) in terms of hardware and software. As we shall see, thinking about software and hardware as being opposite ends of the same spectrum helps map robot makers' differing attitudes about what constitutes a robot.

Concept and function, on the other hand, deal with higher-order questions, which are, in principal, less tied to current technical development. We stress the principal nature of this feature, because in practice most of the interviewed robot makers have their answers thoroughly grounded in the current state of robotics as machines. In theoretical terms, the pool of cultural resources available to robot makers, i.e. their imagination horizon, contains a sophisticated, practice-based vocabulary for discussing robots in terms of technological components (e.g. actuators, servo-motors, and sensors). They often contrast this with the more widely shared cultural representations of robots, such as those of Hollywood movies and science fiction literature. Questions that fall within the theme of concept and function are: What is the purpose of robots in society? Are there certain roles, which robots should never fill? What will robots be like in the future?

Our findings within this theme ties in with the robot developers' understanding of themselves as working for the benefit of society at large, having a genuine interest in doing good (*see 4.0 Ethics Beyond Safety*).

8.3.1 Materiality and processes

We frame our findings under the theme of materiality and processes by invoking the previously mentioned spectrum, with hardware and software occupying the extreme ends. Put differently, someone might suggest robots are primarily characterized as a particular configuration of materials and less so, or not at all, by the (equally material) program being run on the platform. In the REELER data, the vast majority of robot makers agree that robots must be physical things, tangible in the everyday day life. They also agree that this is not sufficient, and most of them are adamant that both materiality and software process are required:

> *It has software, it has mechanics and it has hardware. And it can't work without any of those (...). Pure robotics people in the university will understand robotics as just software, but in the real world you need all of them, and you cannot work without the other.*
>
> (Edgar, system architect, robot developer, SPECTRUS)

As artificial intelligence is increasingly built into the carcass of robots, some robot makers become willing to see robots in the future as pure software. The vast majority of robot makers are somewhere in between the two extremes; conceiving robots as either a material thing animated by software, or as the physical instantiations of the software. Here, we find the mentions of artificial intelligence (AI) and often machine learning (ML) as part of what constitutes a robot.[3] The connection between robots and AI helps provide the physical anchoring of some hybrid imaginaries, which blend fears about future AI systems taking over the world with ideas about robots (Bostrom 2012). This also leads some robot developers to suspect that definitions of robots will put more emphasis on software in the future, given that the development of AI (ML in particular) seems to be racing ahead and about to have a more substantial impact on the field of robotics. We shall return to this point in 8.3.2.

A clear trend in the data is that a robot is an entity, which carries out three connected processes: (i) sensing the environment, (ii) analyzing/processing the sensorial data, and (iii) acting on the environment based on that information:

> *To me a robot is a device that sort of senses something and then it processes that data, and then it takes some kind of decision based on that. It's sort of an autonomous decision in a way that some of it is, of course, based on algorithms and so on, some of it could be based on AI or more intelligent ways of doing it. But it's something that senses, processes the data and then it does something that reacts.*
>
> (Samuel, product innovation manager, robot maker, SPECTRUS)

This triad of sensing, processing and reacting is often coupled with adjectives such as 'predictable' and 'reliant', meaning that given a specific input, you would be sure to get a certain output.

The characteristics listed above are, in fact, true of many machines that are typically not associated with robots; a dishwasher, for instance. Some robot makers are happy to concede this point, others less so as they would demand the robot exhibits some form of intelligent behavior. In brief, on the theme of materiality and processes, we find that although no dominant definition of robots exists, there seems to be

3 Machine Learning (ML), understood as learning systems, which are not explicitly programmed, is a sub-category of the field of artificial intelligence (AI). Often ML is contrasted with symbolic or Good Old-fashioned AI (GOFAI) (Haugeland 1985), which is based on explicit programming, i.e. systems encoded with rules, often stated in terms of if X then Y. See Russell & Norvig 2009.

consensus among robot makers that a robot is characterized by physical entities comprised of a suitable mixture of hardware and software, which process data following roughly the schema of input-process-output in a reliable way.

8.3.2 Concept and function

Our findings on the theme of concept and function revolve around three main adjectives and one noun used to describe the functioning of robots. We asked most of our interviewees, both affected stakeholders and robot makers, to name five words they associate with the term *robot*.[4] The three words presented below are the more frequent responses, in order of significance and rate of occurrence.

1. Autonomous.
2. Helpful.
3. Intelligent.

Most robot makers describe robots as having some amount of autonomy, and many describe robots as being helpful or supportive of humans, while some robot makers describe robots as intelligent, although they rarely specify what they mean by intelligence.[5]

One noun is used across our cases to describe robots: machine. Yet, machine is used in at least two different ways to evoke different connotations, as is exemplified in the two following quotations:

> *The problem is not the physical robot, the problem is the mind of the robot, because I think the intelligence of the machines is growing and it's growing very fast. I think, now it [the robot] is more intelligent than the humans.*
>
> (Hugo, mechanical engineer, robot developer, HERBIE)

> *So, it [the robot] is a device, it's a different way of interaction, if you compare to a screen, but it's always a device. I have no imaginary of robots as something different than a machine.*
>
> (Alba, robot developer, REGAIN)

4 See Annex 1 (responsiblerobotics.eu/annex-1) for a discussion of how interviewers followed our interview guide.

5 Just as for the term robot there is no universally accepted definition of intelligence in the literature. For an overview see Legg & Hutter 2009.

Robot makers thinking about robots as *"just a machine"* (Monika, scenario developer at robotics start-up, robot maker, ATOM) play on the connotations brought out by the definition of machine:

1) An assemblage of parts that transmit forces, motion, and energy one to another in a predetermined manner.
2) An instrument (such as a lever) designed to transmit or modify the application of power, force, or motion.[6]

In the literature (e.g. Nevejans 2016), some scholars have played on the same connotations. Nathalie Nevejans is an appointed expert on law and ethics in robotics by the European Commission, and in her discussion of the 'European civil law rules in robotics', she presents the robot as a lifeless material artefact when providing definitions like, "a mere machine, a carcass devoid of consciousness, feelings, thoughts or its own will … just a tool … inert … inhuman … non-living, non-conscious entity" (ibid., 15-16). Using the word *machine* in this way is often coupled with framing robots as tools. In this sense, it would be wrong to make:

> *The person think that the robot is his friend, and it will help him in anything. It's just a robot, it's a tool you can use or you cannot. You cannot confuse [trick] that person to think that it [the robot] is going to be a friend.*
>
> (Nima, robot designer, robot developer, BUDDY)

Building such a robot would, from this perspective, mean creating an illusion of the robot being something more than it is, namely an entity capable of forming real relations with people. We will return to this discussion in the following section.

In the quotation by Hugo in the beginning of this section, we find the word *machine* used as a descriptor, which might apply to any mechanical system. It also serves as a neutral contrast to the materiality of robots and humans; robots are made of different arrangements of atoms than humans, but might be no different in principle. This stream of thought also exists in the literature, as for instance in the title of the now seminal work by Boden (Boden 2006, *Mind as machine: A history of cognitive science.*). Such discussions are also widespread in the academic literature on ethics with an entire subfield, machine ethics, dedicated to the possibility of machines being moral agents (Sullins 2011). However, in none of the REELER cases did we see any robots displaying anything close to 'humanlike' intelligence. Apart from the appearances of the humanoid robots we saw (in e.g. BUDDY and ATOM), the robots

6 From the Merriam Webster Dictionary. Retrieved from https://www.merriam-webster.com/dictionary/machine

looked like machines – and even the humanoid turned out to run on the same types of materials as the machinelike robots.

In the list of associations to the word *robot* among REELER robot makers, *autonomous* was the most frequent. It is important to note that autonomy, in the technical sense, differs somewhat in meaning compared to the way it is used in common parlance and, often, in the philosophical literature on the subject. The word can be translated as self-ruling, and is usually used in this sense, often connected with the notion of free will, when discussed in relation to individuals. However, in the field of robotics, it usually describes systems operating without direct human control. As one robot developer points out:

> *It can do things on its own but anything it does has been pre-programmed by humans.*
>
> (Theo, university researcher, robot developer, SANDY)

This statement is completely in line with what was found across all cases by REELER researchers. All robots had, at some point, to be programmed by humans. It is in this limited sense that the word autonomy mostly shows up in our data, which means autonomy in the traditional (philosophical) sense is very limited with robots at the present state of technological development:

> *These are of course interesting visions, when they [the robots] walk around completely autonomously. They are probably also programmed in the films. They learn everything by themselves. We are very far from this. Here, I have to program every single pose.*
>
> (Alexander, development engineer, robot developer, COBOT)

Autonomous robots are thus understood as robots able to operate without the direct intervention of humans like C3PO in the Star Wars movies. Some robot makers go further and make the strong claim that robots will never be able to progress beyond the present day 'primitive' form of autonomy (and never be able to move like C3PO). Because they are the product of human programming, they will never do anything else than what we program them to:

> *It's impossible, it's completely impossible. Robots will never say: 'I am a robot working in a warehouse, now I'm going to the moon. Yes, that is a good idea, hmm, that's cool.' Never, impossible. It's because they don't understand the nature of programming, programming is just programming.*
>
> (Alph, robotics start-up founder & CEO, robot developer, WAREHOUSE)

In our data, we also find that the robot makers, who claim the opposite, namely that robots can at some point move beyond this form of autonomy, usually connect this with an increase in intelligence. However, as we shall see, the use of the word intelligence also varies among the robot makers. While many use the word *intelligent* to describe robots, they do not ascribe the same semantical meaning to it. For some, the word intelligent is connected to autonomy.

> *The word intelligent is perhaps a bit tricky, but automation and intelligence will probably be attached to it in some way, it can carry out some tasks on its own, right?*
>
> (Elias, university researcher, robot developer, WIPER)

For others, intelligence is synonymous with the ability to do more things, or do the same thing more efficiently. Both things suggest that robot makers operate with a narrow concept of what constitutes intelligence. For the same reason, a calculator can be said to be intelligent, in that it is a very efficient way of computing certain types of mathematical problems. This conception of intelligence is mirrored in the discussions of AI, where 'narrow' or 'domain-specific' AI is often contrasted with general AI (Nilsson 2009). We typically think of intelligence in a general sense, as something going across multiple domains. We even label individuals, who lack general intelligence, but possess highly evolved single-domain intelligence as 'savants', which might be a fitting label for some advanced robots that do well within one particular area, but are unable to generalize this proficiency to other areas.

For a third group of interlocutors, the word intelligence suggests something deeper than just behavior. In recent years, machine learning (ML) systems have progressed to a state, where they can display behavior, which, if a human had exhibited the same behavior, would be considered intelligent by some. For instance, using ML systems, it is possible to turn pictures into paintings in the style of Picasso, Monet or other famous painters. But as one robot maker puts it:

> *It's like this, these neural networks that learn how to paint like van Gogh. Surprisingly, the machines are capable of, you know, in a way, making an internal map of what's his style and then you show a picture and they paint; it's really impressive. So how does it work? We don't know. And does it require any understanding of who van Gogh was or anything? No."*
>
> (Edgar, system architect, robot developer, SPECTRUS)

As another robot maker argues, this is not the genuine article, but merely a simulacrum, even if it is called intelligence:

> *You probably know one person with big memory and another person with no big memory, but [that person] is more intelligent, because [he] can solve one problem without previous knowledge about this problem. This is real intelligence. Computers don't have intelligence, only calculus. And the calculus today, the sciences say it's intelligence.*
>
> (Sebastian, CEO, robot maker, HERBIE)

Finally, when we asked the robot makers to name five words associated with robot, many of them mentioned the word *helpful* (or *help* or *helper*). This supports and connects with another finding on ethics that robot makers genuinely want to do good, i.e. make the best possible robots (*see 4.0 Ethics Beyond Safety*). Many robot developers think seriously about how and where robots should be implemented to realize the goal of them doing good with robots as helpers, although it often boils down to being safe and efficient and not being harmful. However, some robot developers see robots as a transformative force, and acknowledge that it has the potential to do both great harm and great good, depending on who is using it.

Other of our interviewees argue that both the robot itself and its use are salient factors in determining the value (often in the moral sense) of a robot. If we follow this line of reasoning, it suggests that the label helpful is subject to this same form of relativity; whether or not a robot is helpful depends partly on the robot itself, but also on where and how it is being used. 'Help' like 'relief' (*see Meaningful Work, section 10.3*) are relational terms, and what we mean by them needs to be aligned (*see also 12.0 Human Proximity*). Like with the word intelligence, we find that few robot makers are explicit about what it precisely means for robots to be helpful. Take for instance the guidelines for safety, which apply to all robots. Often, robot makers will say that robots have to be safe, and they have explicit notions of what safety means in concrete situations (*see 4.0 Ethics Beyond Safety*). This is not the case, when they say robots should be helpful. Here they lack explicit notions of how a robot is helpful. Furthermore, one of our findings in *5.0 Inclusive Design* is that robot makers can fail to take affected stakeholders' lifeworlds into account when designing robots. In the same fashion, it stands to reason that robot makers can fail to grasp what affected stakeholders experience as being truly helpful – and also overlook potential resistance to the help they offer.

8.4 The role of media and robot makers

In the last few years, the presence of robots in the public media has increased immensely. Robots now often appear in movies, literature, on social media, and in the news. This also influences the concept of robots to a high degree. Yet, even with robotic technology said to influence every aspect of living by 2020 (euRobotics aisbl, 2013), most people are still not exposed to robots [7] in their everyday lives. Thus, most people rely on media, in the broad sense, for information about robots. However, according to many robot makers, the information found in public media tends to paint a false picture of the current state of robotics.

In this section, we present our findings on how robot makers perceive the link between media representation of robots and public imaginaries of robots. In particular, we see that while robot makers are right in pointing out the problems of exaggerated media depictions of current robot capabilities, they sometimes contribute to this exaggeration themselves in the way they present their robots – to attract funding or potential buyers. As a consequence, the gap between robot makers' often technically grounded imaginaries of robots and public imaginaries of robots widens.

When we look at the criticism that robot makers levy at media portrayal of robots, we see two different types pertaining to (i) materiality and (ii) concept. The first type of criticism is technical, and it aims at the media portraying robots as more capable than they are, for instance by portraying robots as better at handling the sort of tasks, robot makers try to have them handle. One robot maker puts it:

7 Here, and in the euRobotics report, the term robot excludes what is typically referred to as appliances, even though they fit some robot definitions (see sec. 3)

Science fiction has a role in how robots are conceptualized and represented – as seen in a robotics laboratory. (Photo by Kate Davis)

> *The robot is there to do this and that. Or the robot will do this and that easily in the future. But we are around 20 years from these results. So, the picture [presented by the media] is just simply too far ahead. I have done some interviews and most of the time – thank God – they sent it beforehand, but sometimes not. And then they write such bullshit, which I first of all didn't say that way and second of all, which is simply not true. Well, that is because the press is not very mindful when it comes to technical things. No one checks it and then they just publish it.*
>
> (Nathan, mechatronics engineer, robot developer, COBOT)

According to robot makers, such representations cause fear in the public, leading to increased antipathy towards robots, because people are afraid, they will lose their jobs or robots will harm them. Robot makers point out that such fears are often alleviated by exposure to 'real' robots, which helps reset expectations about what robots are able to do. In the REELER data, we find evidence to support this claim. In *Learning in Practice, section 7.2.1*., we introduce Elif, who is initially fearful robots will destroy everything, but who, upon being shown a video of a real robot by an ethnographer, exclaims that she likes it and think it's a good idea.

Overly positive representations not only evoke fears among affected stakeholders, they also excite robot buyers, who are not technically trained or knowledgeable about robotics, and come to robotics with too high expectations about what robots can do:

> *I will name a typical, hm, who could we take, maybe like retail companies are coming and saying: 'We need a robot to stock up the shelves in our store, I have seen all that on YouTube, the robot reaches out, picks it up, puts it down and it can't be that hard.' So, that means with customers who are not in contact with robotics, their expectations to robotics are extremely high. Probably due to a certain public, yes, everyone shows how great they are, especially the publicly funded projects show off what they have done.*
>
> (Kai, mechanical engineer and cluster leader, robot developer, COBOT)

As indicated, this can actually lead to problems for the robotics companies themselves. Customers and stakeholders' high expectations sets them up to be easily disappointed when confronted with real life robots. This can prove to be a problem for implementation in the workplace, as one robot developer points out:

> *When the robot doesn't demonstrate that level of intelligence and does something which indicates it has a lack of intelligence, like it's facing a wall and it's talking to the wall or something like that, then people have a kind of negative reaction to it. And kind of dismiss it as something useful because it doesn't meet that certain expectation of where they think robots should be.*
>
> (Paul, head of social robotics lab, robot developer, BUDDY)

Nevertheless, robot companies themselves engage in this sort of representation of robots. Across our case studies we find robot makers promoting their robots in ways that represent their robots as more advanced than they currently are. In this way, robot makers inevitably contribute to the same tendency they criticize in media.

> *Not that smooth. Not that functional. I mean, it [the robot in a promotion movie] moved quite in a smooth way, knowing exactly the direction, knowing exactly where the human was. But in the real life, it's not like that [laughter], we all know. And of course, it would require a lot of more inputs.*
>
> (Arturo, engineer, robot developer, REGAIN)

We realize that robot makers are just playing by the rules of regular advertising, as they themselves point out, this is simply what sells:

> *Because it's what people like. When you have an advertisement for a car, why is there always a nice girl driving it? Same thing.*
>
> (Alba, robot developer, REGAIN)

Moreover, some engineers involved in the technical aspects of the robot (who we refer to as robot developers) are typically not part of the process of advertising and selling the robot, and in that sense, they are not to blame for the unrealistic portrayal of robots. However, the presentation of 'more capable' robots and the use of media people as application experts 'overselling' robots seem to be part of an inherent business model found in a majority of REELER cases.

As pointed out in the beginning of the chapter, the general public – affected stakeholders – is far less exposed to robots compared than to, say, refrigerators. Consequently, representations of robots that are not grounded in technical realities help reinforce public imaginaries of robots as more advanced than they currently are, and thereby produce the same imaginaries that robot makers criticize.

The second type of criticism is aimed at popular media, often in the science fiction genre, and the portraying of robots as having fundamentally new qualities, which they do not have at present and might never have, such as full autonomy, (human-like) intelligence and emotions.

> *Their expectations are influenced obviously by science-fiction and what they read or see on the screen. And so, when they see a robot in real life, particularly if it's the first time, they expect it to be just like a robot out of Star Wars or something like that.*
>
> (Paul, head of social robotics lab, robot developer, BUDDY)

Dominik Boesl, formerly of KUKA robotics, has been a staunch voice on this topic, and in a talk at the European Robotics Forum in 2017, Boesl said:

"Last year there were eleven movies in Hollywood that were talking about robotics and AI. And it starts cuddly and nice at Baymax or Hero Number Six, I think it's called in the US. So, a Baymax movie, a Disney movie. Then you have Avengers, Age of Ultron – nice cool action movies. Up to Her and Ex Machina. But eleven movies put robotics and AI and science fiction, for example in this form, in the heads of people. So, this leads, on the one hand, to a completely distorted view on the state of technology today. People believe this is going to be real in ten years. We [i.e. robot developers] know how hard that is, but they [i.e. the general public] don't."

Across REELER cases, the robot makers almost unanimously agree that popular media portrayals of robots as overly technically advanced are harmful.

Such portrayals of robots exploit evolutionarily evolved tendencies. Research has shown that people automatically ascribe human-like mental states to entities that display certain behaviors. When our dog wags its tail at the sight of us, we interpret that behavior as the dog being happy or excited to see us. Similarly, when we interact with robots, particularly social robots, and see them exhibit particular behavior, we likewise tend to ascribe such internal states to the robots (*see e.g. Eyssel, de Ruiter, Kuchenbrandt, Bobinger, & Hegel 2012; Fussell, Kiesler, Setlock, & Yew 2008; Darling 2017*). Robots like Hiroshi Ishiguro's geminoids, Cynthia Breazeal's Kismet, and Invo Labs' Pleo are all examples of this.

> **Anthropomorphism:** *The ascription of internal states characteristic of humans (such as emotions) to non-human entities (such as animals).*

Most recently, Hanson robotics' Sophia garnered attention world-wide for its realism. It has visited the UN and even gained Saudi-Arabian citizenship (Sharkey 2018). These robots all exploit the tendency of humans to anthropomorphize entities exhibiting particular behaviors, even though they are, technically speaking, *just machines* running more or less sophisticated programs – and in some cases seem autonomous while actually being remotely (limb and voice) controlled by a person in an adjoining room (possibly Sophia is also sometimes controlled in this way, or like other human-like robots she can be pre-programmed to answer specific questions). When confronted with robots like professor Ishiguro's doublegänger, which gives the impression of being an entity with full autonomy like the professor himself, it is easy to forget that the display of autonomy is a product of careful staging by the producers. Even if professor Ishiguro's laboratory makes no secret of the technology behind the lively robot engaging in very human-like conversations, it is easy to forget that it is controlled by a human from another room. If not directly controlled by humans, humanlike robots, like most other robots depend on some kind of pre-programming (even when 'self-learning'). They run on the same basic equipment (sensors e.g.) as all other robots and would go nowhere without a battery, which has to be provided and charged by their creators. Robots that are not run directly from behind the scene by humans (wizard-of-oz technology) would soon become a boring conversationalist, if programmers did not continually work to update their software. And, humanoids would be of no interest if the human beings, who interact with them, are not willing to be mystified, and disregard those of the robots' remarks that are nonsensical.

Robot makers, both in our interviews and in public, often express a wish to distance themselves from exaggerated public media representations of robots as more technically advanced than they currently are. Therefore, it is worth pointing out that promotional content produced by application experts at the behest of robotics companies can end up reinforcing that same imaginary when actively exploiting human tendency to anthropomorphize.

8.5 Concluding remarks on Imaginaries

All affected stakeholders are exposed to imaginaries of robots. However, those who actually experience robots soon get a new perspective closer to the one shared by robot developers: that robots are machines. However, also within the inner circle of robotics we find policymakers and ethicists who deal with robots as if they were a kind of new species which can be attributed moral agency. None of the robots studied in REELER, across all cases, have warranted this kind of discussion. Apart from the appearances of the humanoid robots (in e.g. BUDDY and ATOM), the robots look like machines – and even the humanoid turned out to run on the same types of materials as the machinelike robots. Debating robots as moral agents thus seem far from the debates REELER can identify as needed, when considering robots in the daily lives of humans. Many issues tied to affected stakeholders can be seen as a clash between expectations. The distantly affected stakeholders, who have never seen a robot, simply envision robots to be as agile and intelligent as humans. Consequently, it comes as surprise when a robot is, for instance, much slower than a human (*see 10.0 Meaningful Work, section 10.2*). If the concept *autonomous* is connected to being self-ruling, then the robots we have seen in REELER are not autonomous nor have a free will. Humans are always involved, also when robotic systems are described as free of direct human control. In light of this, we argue for a reality check (for instance helped by alignment experts, as presented in *12.0 Human Proximity*). Public discussions of robots have been too preoccupied with discussions pertaining to the sort of robots our interviewees criticize as being fictional, conjured up by public media. Instead, REELER wish to direct attention to discussions about robots that are real and currently causing real good and posing real problems in workplaces all over the world.