We are creating a unified UKRI website that brings together the existing research council, Innovate UK and Research England websites.
If you would like to be involved in its development let us know.

Principles of robotics

Regulating robots in the real world

In September 2010, experts drawn from the worlds of technology, industry, the arts, law and social sciences met at the joint EPSRC and AHRC Robotics Retreat to discuss robotics, its applications in the real world and the huge amount of promise it offers to benefit society.

Robots have left the research lab and are now in use all over the globe, in homes and in industry. We expect robots in the short, medium and long term to impact our lives at home, our experience in institutions, our national and our global economy, and possibly our global security.

However, the realities of robotics are still relatively little known to the public where science fiction and media images of robots have dominated. One of the aims of the meeting was to explore what steps should be taken to ensure that robotics research engages with the public to ensure this technology is integrated into our society to the maximum benefit of all of its citizens. As with all technological innovation, we need to try to ensure that robots are introduced from the beginning in a way that is likely to engage public trust and confidence; maximise the gains for the public and commerce; and proactively head off any potential unintended consequences.

Given their prominence it is impossible to address the governance of robotics without considering Asimov's famous three laws of robotics. (Asimov’s laws stated that a robot was not allowed to do anything that would harm a human being; that a robot should always obey a human; and that a robot should defend itself so long as this did not interfere with the first two rules.)

Although they provide a useful departure point for discussion Asimov's rules are fictional devices. They were not written to be used in real life and it would not be practical to do so, not least because they simply don't work in practice. (For example, how can a robot know all the possible ways a human might come to harm? How can a robot understand and obey all human orders, when even people get confused about what instructions mean?)

Asimov's stories also showed that even in a world of intelligent robots, his laws could always be evaded and loopholes found. But finally, and most importantly, Asimov's laws are inappropriate because they try to insist that robots behave in certain ways, as if they were people, when in real life, it is the humans who design and use the robots who must be the actual subjects of any law.

As we consider the ethical implications of having robots in our society, it becomes obvious that robots themselves are not where responsibility lies. Robots are simply tools of various kinds, albeit very special tools, and the responsibility of making sure they behave well must always lie with human beings.

Accordingly, rules for real robots, in real life, must be transformed into rules advising those who design, sell and use robots about how they should act. The meeting delegates devised such a set of "rules" with the aim of provoking a wider, more open discussion of the issues. They highlight the general principles of concern expressed by the Group with the intent that they could inform designers and users of robots in specific situations. These new rules for robotics (not robots) are outlined below.

The five ethical rules for robotics are intended as a living document. They are not intended as hard-and-fast laws, but rather to inform debate and for future reference. Obviously a great deal of thinking has been done around these issues and this document does not seek to undermine any of that work but to serve as a focal point for useful discussion.

The delegates of the workshop were:

- Professor Margaret Boden, University of Sussex
- Dr Joanna Bryson, University of Bath
- Professor Darwin Caldwell, Italian Institute of Technology
- Professor Kerstin Dautenhahn, University of Hertfordshire
- Professor Lilian Edwards, University of Strathclyde
- Dr Sarah Kember, Goldsmiths, University of London
- Dr Paul Newman, University of Oxford
- Geoff Pegman, RU Robots Ltd
- Professor Tom Rodden, University of Nottingham
- Professor Tom Sorell, University of Birmingham
- Professor Mick Wallis, University of Leeds
- Dr Blay Whitby, University of Sussex
- Professor Alan Winfield, UWE Bristol
- Vivienne Parry (Chair)

Principles for designers, builders and users of robots

Note: The rules are presented in a semi-legal version; a more loose, but easier to express, version that captures the sense for a non-specialist audience and a commentary of the issues being addressed and why the rule is important.

	LEGAL	GENERAL AUDIENCE	COMMENTARY
1	Robots are multi-use tools. Robots should not be designed solely or primarily to kill or harm humans, except in the interests of national security.	Robots should not be designed as weapons, except for national security reasons.	Tools have more than one use. We allow guns to be designed which farmers use to kill pests and vermin but killing human beings with them (outside warfare) is clearly wrong. Knives can be used to spread butter or to stab people. In most societies, neither guns nor knives are banned but controls may be imposed if necessary (e.g. gun laws) to secure public safety. Robots also have multiple uses. Although a creative end-user could probably use any robot for violent ends, just as with a blunt instrument, we are saying that robots should never be **designed** solely or even principally, to be used as weapons with deadly or other offensive capability. This law, if adopted, limits the commercial capacities of robots, but we view it as an essential principle for their acceptance as safe in civil society.

	LEGAL	GENERAL AUDIENCE	COMMENTARY
2	Humans, not robots, are responsible agents. Robots should be designed; operated as far as is practicable to comply with existing laws & fundamental rights & freedoms, including privacy.	Robots should be designed and operated to comply with existing law, including privacy.	We **can** make sure that robot actions are designed to obey the **laws** humans have made. There are two important points here. First, of course no one is likely deliberately set out to build a robot which breaks the law. But designers are not lawyers and need to be reminded that building robots which do their tasks as well as possible will sometimes need to be balanced against protective laws and accepted human rights standards. Privacy is a particularly difficult issue, which is why it is mentioned. For example, a robot used in the care of a vulnerable individual may well be usefully designed to collect information about that person 24/7 and transmit it to hospitals for medical purposes. But the benefit of this must be balanced against that person's right to privacy and to control their own life e.g. refusing treatment. Data collected should only be kept for a limited time; again the law puts certain safeguards in place. Robot designers have to think about how laws like these can be respected during the design process (e.g. by providing off-switches). Secondly, this law is designed to make it clear that robots are just tools, designed to achieve goals and desires that **humans** specify. Users and owners have responsibilities as well as designers and manufacturers. Sometimes it is up to designers to think ahead because robots may have the ability to learn and adapt their behaviour. But users may also make robots do things their designers did not foresee. Sometimes it is the owner's job to supervise the user (e.g. if a parent bought a robot to play with a child). But if a robot's actions do turn out to break the law, it will always be the responsibility, legal and moral, of one or more human beings, not of the robot (We consider how to find out who is responsible in law 5, below).

	LEGAL	GENERAL AUDIENCE	COMMENTARY
3	Robots are products. They should be designed using processes which assure their safety and security.	Robots are products: as with other products, they should be designed to be safe and secure.	Robots are simply not people. They are pieces of technology their owners may certainly want to protect (just as we have alarms for our houses and cars, and security guards for our factories) but we will always value human safety over that of machines. Our principle aim here, was to make sure that the safety and security of robots in society would be assured, so that people can trust and have confidence in them. This is not a new problem in technology. We already have rules and processes that guarantee that, e.g. household appliances and children's toys are safe to buy and use. There are well worked out existing consumer safety regimes to assure this: e.g. industry kite-marks, British and international standards, testing methodologies for software to make sure the bugs are out, etc. We are also aware that the public knows that software and computers can be "hacked" by outsiders, and processes also need to be developed to show that robots are secure as far as possible from such attacks. We think that such rules, standards and tests should be publicly adopted or developed for the robotics industry as soon as possible to assure the public that every safeguard has been taken before a robot is ever released to market. Such a process will also clarify for industry exactly what they have to do. This still leaves a debate open about how far those who own or operate robots should be allowed to protect them from e.g. theft or vandalism, say by built-in taser shocks. The group chose to delete a phrase that had ensured the right of manufacturers or owners to include "self defence" capability into a robot. In other words we do not think a robot should ever be "armed" to protect itself. This actually goes further than existing law, where the general question would be whether the owner of the appliance had committed a criminal act like assault without reasonable excuse.

	LEGAL	GENERAL AUDIENCE	COMMENTARY
4	Robots are manufactured artefacts. They should not be designed in a deceptive way to exploit vulnerable users; instead their machine nature should be transparent.	Robots are manufactured artefacts: the illusion of emotions and intent should not be used to exploit vulnerable users.	One of the great promises of robotics is that robot toys may give pleasure, comfort and even a form of companionship to people who are not able to care for pets, whether due to rules of their homes, physical capacity, time or money. However, once a user becomes attached to such a toy, it would be possible for manufacturers to claim the robot has needs or desires that could unfairly cost the owners or their families more money. The legal version of this rule was designed to say that although it is permissible and even sometimes desirable for a robot to sometimes give the impression of real intelligence, anyone who owns or interacts with a robot should be able to find out what it really is and perhaps what it was really manufactured to do. Robot intelligence is artificial, and we thought that the best way to protect consumers was to remind them of that by guaranteeing a way for them to "lift the curtain" (to use the metaphor from The Wizard of Oz). This was the most difficult law to express clearly and we spent a great deal of time debating the phrasing used. Achieving it in practice will need still more thought. Should all robots have visible bar-codes or similar? Should the user or owner (e.g. a parent who buys a robot for a child) always be able to look up a database or register where the robot's functionality is specified? See also rule 5 below.

	LEGAL	GENERAL AUDIENCE	COMMENTARY
5	The person with legal responsibility for a robot should be attributed.	It should be possible to find out who is responsible for any robot.	In this rule we try to provide a practical framework for what all the rules above already implicitly depend on: a robot is never legally responsible for anything. It is a tool. If it malfunctions and causes damage, a human will be to blame. Finding out who the responsible person is may not however be easy. In the UK, a register of who is responsible for a car (the "registered keeper") is held by DVLA; by contrast no one needs to register as the official owner of a dog or cat. We felt the first model was more appropriate for robots, as there will be an interest not just to stop a robot whose actions are causing harm, but people affected may also wish to seek financial compensation from the person responsible. Responsibility might be practically addressed in a number of ways. For example, one way forward would be a licence and register (just as there is for cars) that records who is responsible for any robot. This might apply to all or only operate where that ownership is not obvious (e.g. for a robot that might roam outside a house or operate in a public institution such as a school or hospital). Alternately, every robot could be released with a searchable online licence which records the name of the designer /manufacturer and the responsible human who acquired it (such a licence could also specify the details we talked about in rule 4 above). There is clearly more debate and consultation required. Importantly, it should still remain possible for legal liability to be shared or transferred e.g. both designer and user might share fault where a robot malfunctions during use due to a mixture of design problems and user modifications. In such circumstances, legal rules already exist to allocate liability (although we might wish to clarify these, or require insurance). But a register would always allow an aggrieved person a place to start, by finding out who was, on first principles, responsible for the robot in question.

Seven High-Level Messages

In addition to the above principles the group also developed an overarching set of messages designed to encourage responsibility within the robotics research and industrial community, and thereby gain trust in the work it does. The spirit of responsible innovation is, for the most part, already out there but we felt it worthwhile to make this explicit. The following commentary explains the principles.

	PRINCIPLE	COMMENTARY
1	We believe robots have the potential to provide immense positive impact to society. We want to encourage responsible robot research.	This was originally the "0th" rule, which we came up with midway through. But we want to emphasize that the entire point of this exercise is positive, though some of the rules can be seen as negative, restricting or even fear-mongering. We think fear-mongering has already happened, and further that there are legitimate concerns about the use of robots. We think the work here is the best way to ensure the potential of robotics for all is realised while avoiding the pitfalls.
2	Bad practice hurts us all.	It's easy to overlook the work of people who seem determined to be extremist or irresponsible, but doing this could easily put us in the position that GM scientists are in now, where nothing they say in the press has any consequence. We need to engage with the public and take responsibility for our public image.

	PRINCIPLE	COMMENTARY
3	Addressing obvious public concerns will help us all make progress.	The previous note applies also to concerns raised by the general public and science fiction writers, not only our colleagues.
4	It is important to demonstrate that we, as roboticists, are committed to the best possible standards of practice.	as above
5	To understand the context and consequences of our research we should work with experts from other disciplines including: social sciences, law, philosophy and the arts.	We should understand how others perceive our work, what the legal and social consequences of our work may be. We must figure out how to best integrate our robots into the social, legal and cultural framework of our society. We need to figure out how to engage in conversation about the real abilities of our research with people from a variety of cultural backgrounds who will be looking at our work with a wide range of assumptions, myths and narratives behind them.
6	We should consider the ethics of transparency: are there limits to what should be openly available	This point was illustrated by an interesting discussion about open-source software and operating systems in the context where the systems that can exploit this software have the additional capacities that robots have. What do you get when you give "script kiddies" robots? We were all very much in favour of the open source movement, but we think we should get help thinking about this particular issue and the broader issues around open science generally.
7	When we see erroneous accounts in the press, we commit to take the time to contact the reporting journalists.	Many people are frustrated when they see outrageous claims in the press. But in fact science reporters do not really want to be made fools of, and in general such claims can be corrected and sources discredited by a quiet & simple word to the reporters on the byline. A campaign like this was already run successfully once in the late 1990s.

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Robot rights violate human rights, experts warn EU

COMMENTS

By **Alice Cuddy** • Updated: 13/04/2018

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Leading experts in robotics and artificial intelligence have warned the European Commission that plans to grant robots legal status are “nonsensical and non-pragmatic” — and that doing so could breach human rights.

In an open letter, more than 150 experts in robotics, artificial intelligence, law, medical science and ethics, warned the Commission against approving a proposal that envisions a special legal status of “electronic persons” for the most sophisticated, autonomous robots.

“Creating a legal status of electronic ‘person’ would be ideological and nonsensical and non-pragmatic,” the letter says.

The group said the proposal, which was approved in a resolution by the European Parliament last year, is based on a perception of robots "distorted by science fiction and a few recent sensational press announcements."

“From an ethical and legal perspective, creating a legal personality for a robot is inappropriate”, they argued, explaining that doing so could breach human rights law.

The experts said Europe should create rules for robotics and artificial intelligence that foster innovation, but also consider the “societal, psychological and ethical impacts.”

“The benefit to all humanity should preside over the framework for EU civil law rules in robotics and artificial intelligence,” the letter says.

The European Parliament resolution, which stresses that robots must serve humanity and not be used to cause damage, is part of efforts by the bloc to prepare for major advances in technology.

‘‘Humankind stands on the threshold of an era when ever more sophisticated robots, bots, androids and other manifestations of artificial intelligence seem poised to unleash a new industrial revolution, which is likely to leave no stratum of society untouched, it is vitally important for the legislature to consider all its implications,’’ it says.

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Sign the letter

We, Artificial Intelligence and Robotics Experts, industry leaders, law, medical and ethics experts, confirm that establishing EU-wide rules for Robotics and Artificial Intelligence is pertinent to guarantee a **high level of safety and security to the European Union citizens** while fostering **innovation**.

As human-robot interactions become common place, the European Union needs to offer the appropriate framework to **reinforce Democracy and European Union values.** In fact, the Artificial Intelligence and Robotics framework must be explored not only through economic and legal aspects, but also through its societal, psychological and ethical impacts. In this context, we are **concerned** by the European Parliament Resolution on Civil Law Rules of Robotics, and its recommendation to the European Commission in its paragraph 59 f):

> "Creating a specific **legal status for robots** in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently;"

WE BELIEVE THAT:

1. The economical, legal, societal and ethical impact of AI and Robotics must be considered without haste or bias. The benefit to all humanity should preside over the framework for EU civil law rules in Robotics and Artificial Intelligence.

2. The creation of a **Legal Status** of an "electronic person" for "autonomous", "unpredictable" and "self-learning" robots is justified by the incorrect affirmation that damage liability would be impossible to prove.

From a **technical** perspective, this statement offers many bias based on an overvaluation of the actual capabilities of even the most advanced robots, a superficial understanding of unpredictability and self-learning capacities and, a robot perception distorted by Science-Fiction and a few recent sensational press announcements.

From an **ethical** and **legal** perspective, creating a legal personality for a robot is inappropriate whatever the legal status model:

a. A legal status for a robot can't derive from the **Natural Person model**, since the robot would then hold human rights, such as the right to dignity, the right to its integrity, the right to remuneration or the right to citizenship, thus directly confronting the Human rights. This would be in contradiction with the **Charter of Fundamental Rights of the European Union** and the **Convention for the Protection of Human Rights and Fundamental Freedoms.**

b. The legal status for a robot can't derive from the **Legal Entity model**, since it implies the existence of human persons behind the legal person to represent and direct it. And this is not the case for a robot.

c. The legal status for a robot can't derive from the **Anglo-Saxon Trust model** also called ***Fiducie*** or ***Treuhand*** in Germany. Indeed, this regime is extremely complex, requires very specialized competences and would not solve the liability issue. More importantly , it would still imply the existence of a human being as a last resort – the trustee or fiduciary – responsible for managing the robot granted with a Trust or a *Fiducie*.

CONSEQUENTLY, WE AFFIRM THAT

> The European Union must prompt the development of the AI and Robotics industry insofar as to limit health and safety risks to human beings. The protection of robots' users and third parties must be at the heart of all EU legal provisions.

> The European Union must create an actionable framework for innovative and reliable AI and Robotics to spur even greater benefits for the European peoples and its common market.

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> Sanja Dogramadzi, Professor of Medical Robotics at UWE, **Bristol Robotics Laboratory** (**United Kingdom**). Member of **British Standard Institute** contributing to developments of Robotics standards for Service and Medical Robotics

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> Margo Dessertenne, Trade groups manager at **Symop Robotics** (**France**). Symop is a French professional organization gathering 270 SME enterprises and large corporations in Automation, robotics

> David Pavlovic , Head of digital strategy & innovation, **Heineken** (**Netherlands**).

> Lionel Sublet, CEO, Techplus , Symop Robotic Group General Manager **(France).**

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> Ante Čović, **Director at the Centre of excellence for Integrative Bioethics**, Vice-Rector for Organisation, Human Resources Development and Cross-University Cooperation (**Croatia**). .

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> Joanna Bryson, Reader (Associate Professor), University of Bath (**United Kingdom**). Expert in both AI, safety and transparency in intelligent systems, and AI ethics.

> Alan Winfield, Professor of Robot Ethics at **UWE Bristol**, Robotics Laboratory, (**United Kingdom**). Member of the British Standards Institute working group on Robot Ethics; Member of the EC **Human Brain Project** Ethics Advisory Board; Member, Executive committee, **IEEE** Global Initiative on Ethics of Autonomous and Intelligence Systems and **Chair, IEEE Standards Working Group P7001** on Transparency in Autonomous Systems; Member, WEF Global Futures Council on The Future of Technology, Values and Policy

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> **Miguel Enrique Burguete**, PhD. Professor of **Philosophical Anthropology and Biopolitics**, Institute of Life Sciences and Observatory of Bioethics of the Catholic University of Valencia (**Spain**)

> **Calum MacKellar**, **Director of Research**, **Scottish Council on Human Bioethics**, Ethics Committee (**Scotland**)

> **Richard Everson**, Professor of **Machine Learning** , University of Exeter (**United Kingdom**), **Director** of the Exeter University **Institute for Data Science and Artificial Intelligence**

> **Richard Ashcroft**, Professor of Bioethics, School of Law, Queen Mary University of London (**United Kingdom**), **Director of the LLM in Medical Law**

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> **Thierry Magnin**, Professor in Ethics of Sciences and Technologies, **Rector** of the Lyon Catholic University (**France**). Member of The **French National Academy of Technologies**.

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> **Christopher Markou**, The University of **Cambridge**, Lecturer (**United Kingdom**). **Legal Expert Committee, Responsible for Robotics**.

> **David Doat**, **Chair of Ethics & Transhumanism**, Chair of Lille Catholic University **(France)**

> **Rónán Kennedy**, Lecturer in Law, National University of Ireland Galway (**Ireland**).

See more signatories

WHY YOU SHOULD SIGN:

The European Commission has planned to issue a communication on Robotics and AI as a consequence of the Resolution on Civil Law Rules of Robotics Resolution.

If you are :

> From one of the 28 Member-States of the European Union

> An AI/ Robotics Scientist or manufacturer, a University Scholar in Law, Medicine, a Member of a Professional Organization or of an Ethics Committee

> Concerned by the way Artificial Intelligence and Robots will change our daily lives and our civil, commercial and criminal laws

Please join us in the Open Letter to protect EU innovation, EU values as well as human safety, security and health.

Sign the letter

WHO IS THIS ROBOTICS OPEN LETTER ADDRESSED TO:

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This Robotics Open Letter is addressed to the European Commission and namely:

European Commission President – Jean Claude Juncker
Commissioner Research, Science and Innovation – Carlos Moedas
Commissioner Digital Economy and Society – Mariya Gabriel
Commissioner Justice, Consumers and Gender Equality – Věra Jourová
Commissioner Employment, Social Affairs, Skills and Labour Mobility – Marianne Thyssen
Commissioner Transport – Violeta Bulc
Directorate General CONNECT
Directorate General GROW
Directorate General JUST
Directorate General RTD

CIVIL LAW RULES ON ROBOTICS

On February 16 2017, the European Parliament adopted a Resolution on Civil Law Rules of Robotics.

This resolution reads in its paragraph 59 f) : *"Creating a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently;"*

In fact, a delegating amendment for §59 f) was tabled and 285 Members of Parliament voted in favor of its deletion.

Prior to the vote, Mrs Delvaux the Luxemburgese Member of the European Parliament who drafted the Resolution, wrote a communication to all members of Parliament clarifying her intentions in the Resolution:

> "In the long run, determining responsibility in case of an accident will probably become increasingly complex as the most sophisticated autonomous and self-learning robots will be able to take decision which cannot be traced back to a human agent. For these cases, the report asks the Commission to carry out an impact assessment for a compulsory insurance scheme, which includes the possible idea of giving the legal status of an electronic personality to robots in order to facilitate compensation for victims when human responsibility cannot be fully attributed. Liability is in fact a central part of this report, because it is indispensable for citizens' trust."

WHO ARE WE ?

We are Political Leaders, AI/robotics researchers and industry leaders, Physical and Mental Health specialists, Law and Ethics experts gathered to voice our concern about the negative consequences of a legal status approach for robots in the European Union.

Fostering an actionable framework for civil law rules on robotics and AI consequently addressing the issue of liability of "autonomous" robots is our goal. However, we believe that creating a legal status of electronic "person" would be ideological and non-sensical and non-pragmatic.

The European Economic and Social Committee clearly stated in its opinion "The consequences of Artificial Intelligence on the (digital) single market, production, consumption, employment and society" §3.33 that they were opposed to any form of legal status for robots or AI.

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Similarly, UNESCO's COMEST * report on Robotics Ethics of 2017, share a similar point of view : in the article 201 where they find "highly counterintuitive to call them 'persons' as long as they do not possess some additional qualities typically associated with human persons, such as freedom of will, intentionality, self-consciousness, moral agency or a sense of personal identity. It should be mentioned in this context, however, that the Committee on Legal Affairs of the European Parliament, in its 2016 Draft Report with recommendations to the Commission on Civil Law Rules on Robotics, already considers the possibility of "creating a specific legal status for robots, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons with specific rights and obligations, including that of making good any damage they may cause, and applying electronic personality to cases where robots make smart autonomous decisions or otherwise interact with third parties independently" (JURI, 2016, section 59.f).

* : COMEST is the World Commission on the Ethics of Scientific Knowledge and Technology from UNESCO

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Robot rights - a legal necessity or ethical absurdity?

By Kurt Marko January 3, 2019

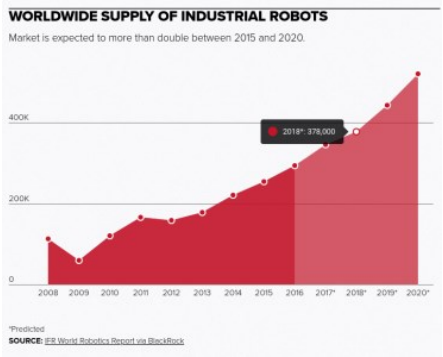
Dyslexia mode

SUMMARY: The question of robot rights has emerged as a much more nuanced topic than at first seems the case. We examine the pros and cons.

0 Comments

We're almost two decades past a world where machines like HAL 9000 gained enough self-awareness to commit spaceship mutiny, but dystopian visions of robots run amok re-emerge every time Boston Dynamics releases a promotional video.

Given the fears of robot-induced mass unemployment or autonomic warriors of unchecked destructive power, it might seem ironic then that the issue of *robot rights*, has become a matter of serious policy debate.



I'll admit to being skeptical when reading a recent column decrying the plight of poor, abused robots, but upon further review, the question of whether autonomous, adaptive, aka learning machines, have or need rights is nuanced and worthy of debate. The legal status of quasi-intelligent machines capable of independent action is sure to vex developers, manufacturers, politicians, and legal scholars for many years as technology advances outpace our legal and regulatory frameworks. Here's a preview of what will be a discussion that's sure to heat up in 2019.

What are rights and how can machines possess them?

My initial reaction on encountering the concept of robot rights was somewhere between skepticism and derision since I reflexively conflated "rights" with human or ethical rights. These are the rights of the Enlightenment, Declaration of Independence and Bill of Rights, but they are only one category, namely natural rights, of a broader philosophical and legal framework.

The notion that any unconscious machine, regardless of its patina of intelligence, has the same innate claim on life, liberty, self-determination and the pursuit of happiness as a human being seems preposterous. However, our judicial systems also confer legal rights *and obligations* on individuals and other entities, notably corporations, that are independent of one's entitlements as a human being.

I was drawn down the natural rights rabbit hole by a recent article by Andrew Sherman, an attorney specializing in business law and IP that argued for extending workplace protections, aka worker's rights, to robots. While not a full-fledged human rights argument, the examples cited in the piece came close to equating the plight of abused laborers that led to the union movement more than a century ago to the situation facing robotic workers in the future. Here's a sample (***emphasis added***),

> *By the year 2025, robots and machines driven by artificial intelligence are predicted to perform half of all productive functions in the workplace.* ***What is not clear is whether the robots will have any worker rights****.*
>
> *Humans already have shown hatred toward robots, often kicking robot police resources over or knocking down delivery bots in hopes of reclaiming a feeling of security or superiority. …* ***What is new is that it will only be a matter of time before the automated creatures will 'feel' this hostility and/or feel the need to retaliate.***

The last sentence is highly debatable, perhaps the influence of too many sci-fi movies, since the

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prospect of machines that develop independent, i.e. not just mimicry, emotional feelings, as opposed to the sensory perception that they already possess, is remote. (Here's a decent summary of the debate). Sherman then stumbles into a valid point, just not one justified by his previous argument.

> *These acts of hostility and violence have no current legal consequence — machines have no protected legal rights.* ***But as robots develop more advanced artificial intelligence empowering them to think and act like humans, legal standards need to change****.*

The legal standards pertaining to robots and quasi-intelligent algorithms probably are inadequate, however the more pressing issues pertain to *legal* not *natural* or *human* rights. Unfortunately, he conflates the two while raising a mix of legitimate (***emphasized***) and specious questions.

> *Few are considering this trend from the perspective of the rights of our automated coworkers. What legal standing should the robot in the cubicle next to you have from a labor, employment, civil rights or criminal law perspective, and as a citizen? ...Will humans discriminate against the machines? Will workplace violence or intolerance be tolerated against robots? … Should robots be compensated for their work? How and when? Are they eligible for vacation or medical benefits?* ***What if a robot causes harm to a coworker or customer? Who's responsible?*** *Will robots be protected by unions?* ***If a robot "invents" something in the workplace, or improves a product or service of the company, who or what will own the intellectual property?***

The notion that robots as currently or foreseeably constituted need civil rights or HR benefits is absurd, however questions of criminal and tort responsibility for behavior by or towards robots and IP ownership need updating for an era of autonomous, adaptive, 'intelligent' machines.

Corporate personhood as a model for robot rights

The robot rights debate was ignited in 2017 after a EU Parliament report with recommendations to the Commission on Civil Law Rules on Robotics. Section 56 proposes a reasonable approach given the state of current robotic technology based on deep learning algorithms (***emphasis added***).

> *Considers that, in principle, once the parties bearing the ultimate responsibility have been identified,* ***their liability should be proportional to the actual level of instructions given to the robot and of its degree of autonomy, so that the greater a robot's learning capability or autonomy, and the longer a robot's training, the greater the responsibility of its trainer should be****; notes, in particular, that skills resulting from "training" given to a robot should be not confused with skills depending strictly on its self-learning abilities when seeking to identify the person to whom the robot's harmful behaviour is actually attributable; notes that* ***at least at the present stage the responsibility must lie with a human and not a robot.***

However, Section 59 (f) contains the most controversial proposal raising the rights issue,

> *Creating a specific legal status for robots in the long run, so that at least* ***the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause,*** *and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently.*

Critics fear that granting robotic personhood is just a way for manufacturers to shirk responsibility for what are ultimately defects in software and training data. However the idea of granting legal personhood to various entities, goes back in U.S. law to the seminal Santa Clara County v. Southern Pacific Railroad Co. Supreme Court decision that extended the equal protection rights of the Fourteenth Amendment to corporations and established the legal foundation for corporate personhood. As robots assume more tasks, some entailing life-and-death decisions to humans around them, it seems reasonable to establish a legal framework that addresses and assigns responsibility for their actions *and* inactions.

Separating the philosophical from the legal

The most thorough treatment of robot rights to date is a book by the same name from David Gunkel, a professor of media studies at Northern Illinois University. In an interview for NIU, Gunkel contends that the issue of rights arises from society's evolving views on the status of autonomous machines that has moved them into a gray area between natural persons and things. However, he correctly notes that the legal definition of "person" is not limited to human beings. In Gunkel's words (***emphasis added***),

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> *Person' is a socially constructed moral and legal category that applies to a wide range of different kinds of entities and not just human individuals. In fact,* ***we already live in a world overrun by artificial entities that have the rights (and the responsibilities) of a person—the limited liability corporation****. IBM, Amazon, Microsoft and McDonalds are all legal persons with rights similar to what you and I are granted under the law—the right to free speech, the right to defend ourselves from accusations, the right to religion, etc.* ***If IBM is a legally recognized person with rights, it is possible that Watson—IBM's AI—might also qualify for the same kind of status and protections.***

Gunkel proposes a different way of viewing "the social position and status of technological artifacts" based, not on *what something is,* i.e. conscious, self-aware, capable of pain or emotions, but on how *humans interact with it*, a conceptual model called "the relational turn." As Gunkel puts it,

> *The relational turn puts the how before the what. As we encounter and interact with others—whether they are humans, animals, the natural environment or robots —* ***these other entities are first and foremost situated in relationship to us. Consequently, the question of social and moral status does not necessarily depend on what the other is but on how she/he/it stands before us and how we decide, in "the face of the other," to respond****. Importantly, this alternative is not offered as the ultimate solution or as a kind of 'moral theory of everything.' It is put forward as a kind of counterweight to* ***provide new ways of thinking about our moral and legal obligations to others****.*

The relational model might be useful for addressing the social and legal norms for human-robot interactions as the machines become more advanced and adaptable, but falls short when considering the criminal and tort responsibilities of autonomous, adaptive machines.

My take

Using the relational yardstick, the more humans treat robots like a social peer, friend or colleague, the more rights they should be accorded by our legal system. Of course, the same argument has been made for animal rights, where, at least with domesticated animals, the relational interactions are far stronger across cultures and generations.

While the model might be useful for establishing norms as certain types of robots or machines become human companions, I believe it is doesn't adequately address more pressing issues and of liability for personal and property damage or IP creation and theft. No matter how much we treat a robot like a human colleague or friend, should one go HAL 9000 can it be guilty of premeditated murder or is that the responsibility of the developer and trainer?

I believe we are still many, many years from robots capable of such actions that would force us to face questions of individual or natural rights. Nor do I buy the argument that malicious, gratuitous damage to a robot is some form of hate crime against what are still unfeeling (in the emotional, not sensory sense) automatons. Current property damage and liability statutes seem adequate to cover the occasional Luddite or, conversely, malfunctioning droid.

Instead, I think section 56 of the EU report is the proper approach, namely establishing laws of accountability and damage mitigation structures (like insurance) that reflect the differences between autonomous, adaptive, 'intelligent' robots, and the algorithms that power them, and traditional machines. These must be extended with provisions that define ownership of any IP that such machines might create in the course of their normal use and that is clearly distinct from the underlying algorithms controlling them.

Society and robot developers must also address the rights of humans when dealing with robots, particularly to allay the dystopian fears of rogue destructive behavior. Here, Asimov's Three Laws of Robotics are a philosophical foundation from which to build a code of robotic ethics.

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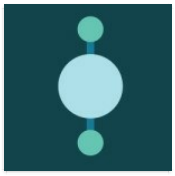

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Review Paper

Roboethics principles and policies in Europe and North America

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Abstract
Robotics and artificial intelligence (AI) are revolutionizing all spheres of human life. From industrial processes to graphic design, the implementation of automated intelligent systems is changing how industries work. The spread of robots and AI systems has triggered academic institutions to closely examine how these technologies may affect the humanity—this is how the fields of roboethics and AI ethics have been born. The identification of ethical issues for robotics and AI and creation of ethical frameworks were the first steps to creating a regulatory environment for these technologies. In this paper, we focus on regulatory efforts in Europe and North America to create enforceable regulation for AI and robotics. We describe and compare ethical principles, policies, and regulations that have been proposed by government organizations for the design and use of robots and AI. We also discuss proposed international regulation for robotics and AI. This paper tries to highlight the need for a comprehensive, enforceable, and agile policy to ethically regulate technology today and in the future. Through reviewing existing policies, we conclude that the European Union currently leads the way in defining roboethics and AI ethical principles and implementing them into policy. Our findings suggest that governments in Europe and North America are aware of the ethical risks that robotics and AI pose, and are engaged in policymaking to create regulatory policies for these new technologies.

Keywords Roboethics · Ethics · Robotics · Artificial intelligence · Governance

1 Introduction

Robotics and artificial intelligence (AI) are having a profound impact on all aspects of everyday life: our food is collected by robots, we are being driven by self-driving vehicles, our phones know what we want to text to our loved ones, and when we get sick, our physician might be a robot. However, as exciting as these technologies are, they come with significant risks for the future of humanity. Over the last 10 years, the number of industrial robots has risen 300% and continues to increase [1]. In the next 10 years, as many as 20 million jobs worldwide may be displaced by industrial robots [2]. Automated systems are replacing not only manual laborers, they are replacing care workers, teachers, lovers, medical professionals, and soldiers. It is highly likely that in the future robots will coexist with humans and contribute to society both physically and intellectually. It is not just the future of jobs that worries the public, but also the possibilities for inequality, decline in social wellbeing, and non-consensual control from corporations and governments [3, 4]. Due to these issues and the overall rise in robotics and AI research and

Sofya Langman and Nicole Capicotto contributed equally to this work

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implementation over the past decade, the development of ethical principles and regulation has become a priority for governments and organizations around the world.

The first attempts to understand the ethics of AI and robotics have come from academic institutions and private corporations, which demonstrates the field's awareness of its potential implications. The study of the ethics of robotics, or roboethics, was pioneered by by Gianmarco Veruggio in the early 2000s [5]. Since then, roboethics and AI ethics have become widely discussed topics, with the number of publications mentioning either of the terms increasing tenfold in the last 5 years [6]. Although many organizations already propose well-considered ethical principles for robotics and AI, the need remains for enforceable ethical regulations on governmental and international levels. The need for regulation is felt by all members of the robotics and AI communities, which is why many non-government organizations have decided to create their own ethical policies independent of law and policy. However, this does not promote standardization of ethics, and allows for moral loopholes which could lead to creation of automated systems that infringe on human rights. Governments have recognized the potential and risks that AI and robotics bring, and have initiated the process for creation of legislation that accounts for ethical concerns in AI and robotics.

The goal of this paper is to summarize ethical frameworks and regulations in Europe and North America with specific focus on how ethical principles have been translated into law by government bodies in the European Union (EU), United States of America (U.S.), and Canada. This paper is structured as follows: we first provide a definition for robots and discuss how theoretical Laws of Robotics have initiated the discussion for ethical robots; we then move on to describe key ethical issues for robots; the following section describes ethical frameworks and regulations for Europe, North America, and as set out by international organizations such as the United Nations; lastly, we provide a brief discussion where we compare the progress made by Europe and North America in creating regulatory policies for robotics and AI, and list action-steps for establishing a regulatory environment that promotes ethical robotics and AI.

2 Foundational principles of robotics and roboethics

While AI-powered robots are a thing of the present, there are examples of miraculous—for the time— machines from ancient civilizations which we can consider the first examples of robots. Al-Jazari, an Arab Muslim scholar from the thirteenth century BC designed wondrous items such as a programmable system for pouring and serving various drinks, a set of robotic musicians, and several water-raising machines [7, 8]. Leonardo da Vinci has also created a humanoid-looking automaton in a shape of a knight that was able move its head and jaw, wave its arms, and sit up [9]. The Industrial Revolution populated new technologies around the world and has permanently changed how people approach manual labor. With the discoveries of electricity, computers, and the internet, inventors were able to create machines and automatons capable of automating processes that were previously performed by humans. A new revolution is currently underway in the workforce, and over 70% of US workers indicate that they are worried about a future when robots and computers can perform human jobs [3]. Similarly, in a study that surveyed over 20,000 EU workers, the majority has indicated that they agree that robots steal people's jobs [10]. As the capabilities of machines have changed, our definitions for robots and.

2.1 Definition of robots

The term "robot" was first introduced by Karel Capek in a play that first premiered in Prague in 1921 [11]. The term, derived from Czech word "rabota" meaning compulsory work, was used to identify artificial laborers that served humans in a fictional Utopian society [11, 12]. Since then, the word "robot" has been popularized through works of science fiction and is now also applied to an array of intelligent mechanical systems. When considering policy design and implementation, it is critical to have a most complete and accurate definition of a robot, since a policy may or may not be applied to an object depending on whether it is classified as a robot. One the most widely accepted definitions for robot is one from the Robot Institute of America: "A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices, through variable programmed motions for the performance of a variety of tasks" [13]. Since the development of AI and the Internet of Things, and the merging of programmable systems with physical operators, the distinction between AI and robots is become more arbitrary [14]. As such, perhaps the most straightforward definition for robot is "an embodied AI" [15].

With the above definitions in mind, a robot should exhibit these three properties [14]:

- Programmability, or an ability for a designer to manipulate robot's functions and capacities;
- Mechanical Capability, enabling a robot to act on its surroundings; and
- Flexibility, allowing the robot to operate in a variety of ways and adapt to different scenarios.

With the emergence of specific robot types, such as social robots, the qualities above may be expanded. This should be considered when attempting to create a policy that should only be applied to a specific type of a robot. While universal policies would be useful in establishing a basic governance of robots, it would be difficult to apply the same policy to a cargo-stacking robot, a self-driving car, and a robotic soldier.

2.2 Asimov's laws of robotics

The term robotics, referring to a branch of engineering that studies robots, was first used by Isaac Asimov in his novel "Runaround" [16, 17]. In the same novel, Asimov has introduced the first set of laws that dictate a robot's behavior [16]. These laws lay the foundation for roboethics and established the first set of boundaries between humans and robots. The Laws of Robotics (Laws) discuss concepts of safety, obedience, and self-preservation:

1. A robot may not injure a human being under any conditions—and, as a corollary, must not permit a human being to be injured because of inaction on [the robot's] part.
2. A robot must follow all orders given by qualified human beings as long as they do not conflict with First Law.
3. A robot must protect [its] own existence, as long as that does not conflict with the First and Second Law.

Asimov later recognized that the First Law did not extend to the human society overall and added an additional Zeroth Law that would supersede the First Law [18]:

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

While these laws were relevant when written in 1942 and 1985 (Clarke, 1993), they are not applicable to robotics today. The Laws employ abstract concepts and require robots to make moral judgements based on difficult-to-calculate probabilities [14]. When Asimov wrote his robots, he was not operating under constraints of reality and technological capability; he could take creative freedoms to smooth over any inconsistencies. To apply these Laws to the current state of robotics, they need to be revised with more specificity. However, when AI reaches the point of singularity, some of Asimov's original Laws may become relevant again.

2.3 Revisions to the Asimov's laws of robotics

When Asimov proposed his Laws of Robotics, he could not envision the technological developments and the geopolitical climate of the twenty-first century. Building on the foundational principles of the Laws, several versions of the new Laws of Robotics have been proposed. According to Murphy and Woods, the main issues with the Laws are that they 1) assume that robots are solely responsible for human safety, 2) fail to explain how robots should interpret orders given by humans, and 3) ignore that many robots lack a self-protective component of autonomy [19]. As a result, the Three Laws of Responsible Robotics focusing on accountability, responsiveness, and control, have been proposed [19]:

1. A human may not deploy a robot without the human–robot work system meeting the highest legal and professional standards of safety and ethics.
2. A robot must respond to humans as appropriate for their roles.
3. A robot must be endowed with sufficient situated autonomy to protect its own existence as long as such protection provides smooth transfer of control to other agents consistent with the first and second laws.

These updated laws recognize that as robots are created by humans, the responsibility for robot actions lies on humans too. Assignment of responsibility is essential when creating legislation and policy, as policy enforcement requires accountability. In addition to that, the Laws of Responsible Robotics recognize that robots are a part of dynamic relationships that are built through human–robot interactions [19]. These new Laws are not exhaustive nor specific, but they provide a more realistic starting point for ethicists and policy makers.

Since 2009 industries have revolutionized their work by employing cloud computing, big data, and cyber-physical systems [20]. The robot industry has reached the point where robots are able to provide an attractive return on investment for replacing manual labor with machines [21]. Some predictions suggest that the number of industrial robot installations will increase 300% in the next 10 years, and in some industries over 40% of manufacturing tasks will become automated [21]. These figures suggest that human–robot co-working is inevitable and will be the next step in industrial evolution. The changes in global industry require a new set of ethical robotics rules, which would protect human workers from capitalistic drivers and guarantee a peaceful coexistence of humans and robots in the same workplace. New technological developments have also spread to the military and medical

sectors, where robots are able to perform such disparate functions as destroying terrorist cells and caring for the elderly. Increases in robotic and AI capabilities has inspired several organizations to develop new robotic principles and manifests [22]. Additionally, the New Laws of Robotics (New Laws) have been proposed in 2020, which take into account morals of human actors [23]:

1. Robotic systems and AI should complement professionals, not replace them;
2. Robotic systems and AI should not counterfeit humanity;
3. Robotic systems and AI should not intensify zero- sum arms races;
4. Robotic systems and AI must always indicate the identity of their creator(s), controller(s), and own er(s).

These New Laws, while not specific, reflect on the current trends in implementation of robots around the world. They take into account the most troubling trends in robotics today, and place hard restrictions on them. The New Laws, however, do not include restrictive language, and cannot be interpreted as a piece of regulatory policy. Given changes already observed in the field, it is likely that there will be other laws proposed in the future. This reflects on the iterative process in both technological developments and policymaking.

3 Ethical questions for robotics policies

The development and marketization of robotics pose many ethical questions for researchers, practitioners, government, and society alike. These ethical questions lay a foundation for ethical principles, which in their turn facilitate creation of roboethical standards such as BS 8611 [24]. The combination of ethical frameoworks and standards informs creation of regulatory policies for robotics. In order to create relevant policy, governments and corporations have proposed various means of evaluating a robot. Here we discuss three categories based on which a robot can be evaluated to create ethical policy.

3.1 Functionality

Robots are designed to perform various functions, from assembly of heavy machinery to patient care. Most commonly robots are designed to perform tasks with utilitarian purpose, where a robot performs repetitive or heavy tasks in a workplace [17]. These robots are often referred to as industrial robots, and they have been responsible for revolutionizing production economies around the world [17, 20]. Robots with more sophisticated mechanical functions were then adapted in medical fields, so we have seen the appearance of medical robots. Rapid advances in AI technology have facilitated development of a whole new class of robots- social robots. Social robots possess an ability to interact with humans, enabling them to perform caregiving, teaching, and customer service functions [25–27]. Outside of professional environment, robots are designed as toys, art objects, or exclusively for user pleasure [28–30]. Robots can now be expected to be involved in all aspects of human life, which undoubtedly will shape society and economy.

Robot's intended functions can pose an array of ethical concerns. While the existence of industrial robots is somewhat accepted, there are questions being raised about how industrial robots will impact the workforce dynamics and the state of the world economy. Many workers are concerned about losing their jobs to robots, and industries are expecting that they will have to retrain their workers due to robot integration [3, 31, 32]. Some countries would be able to survive this industrial revolution, but for developing countries and regions relying on manual labor this change may prove to be disastrous [33]. Social robots present some of the similar challenges in relation to workforce dynamics, but also pose additional questions regarding dehumanization. Expansion of aging population has already caused Japan to look into robotic care for the elderly, and North America and Europe are likely to follow suit [34, 35]. Robotic caregivers may be able to assist with physical side of patient care, but it has been widely acknowledged that human contact is just as important to care and therapy. Care robots are not able to empathize with their charges and could exacerbate the problem that they were designed to solve by perpetuating loneliness and eroding their patient's sense of dignity [35, 36]. Similar concerns can be raised in relation to robot childcare and education, where children may find themselves attached to robots in a way that would impact their social development [37, 38]. It is plausible that in the future robots would be able to perform any function a human can, so current policymakers could start questioning which roles robots should play in human society.

A robot may also have functions that are complimentary to a robot's main function. For example, a robot designed to entertain the elderly may also be collecting user data such as sound, video, etc. Social robots can access user's physical spaces and gain insights on user's innermost thoughts, which could be of special concerns if robots are interacting with vulnerable populations [39]. In this scenario, data handling and ownership pose additional ethical concerns which would need to be addressed through policy. If robots have internet connectivity and upload data to servers, data security would add another layer to the potential regulatory framework.

There is another class of robots whose function is widely debated on an international scale, and which deserve a special mention here: military robots. At least 50 countries have either bought robots for military purposes or have military robotics programs; the U.S. Department of Defense has allocated $7.5 billion to development of unmanned systems in the fiscal year 2021 [40, 41]. Militaries around the world have been using robots to conduct reconnaissance, do surveillance, disarm landmines, and engage with targets [42]. It is the latter kind that is of outmost concern for the ethicists. Lethal autonomous weapon systems (LAWS) offer several advantages for the military: they have a potential to reduce casualties, improve precision, and provide continuous surveillance and analysis of the battlefield [43]. To understand ethical concerns for LAWS, we should ask three questions: 1) What can they do? 2) What should they do? and 3) What is their role in global security and likelihood of future wars? [44] The concern for human dignity is central to ethics of LAWS: they could eliminate the human judgement component from lethal confrontations, thus shifting the ethical burden for taking a life from humans to a machine [44, 45]. Whether LAWS should be able to make life and death decisions and follow up with violence based on that decision is the cornerstone question for ethicists and policymakers. Some researchers argue that LAWS should be under meaningful human control even after deployment, thus limiting the autonomy of such robots and still permitting for human-directed decision-making [42]. This point of view is supported by governmental organizations, for example the European Parliament resolution on a comprehensive European industrial policy on AI and robotics notes that "automated weapons systems should continue to have a human-in-command approach to artificial intelligence" [46]. A survey from 2015 has indicated that the majority of people opposes use of LAWS for offensive purposes and supports international ban of LAWS [47]. If International Humanitarian Law does allow the use of LAWS, it would be the up to robot engineers to create algorithms that determine the extent of human involvement for ethical robotic warfare [48].

3.2 Capability

While two robots might be designed to perform the same function, their capabilities may vary depending on a unit's hardware and software. In other words, a robot that is only capable of simple processing operations cannot be compared to a robot that has sophisticated AI with a capacity for learning. The more advanced the AI, the more ethical questions can be raised to create regulatory policy. With AI that possesses human-like capabilities, one might even start asking whether such sophisticated robots deserve to have rights that would traditionally be granted to intelligent life forms. Further, if a robot starts to develop capacity for independent thought, would it be ethical for humans to regulate it as an object or a property? These questions could be further complicated by the anthropomorphization of robots, which would create an illusion of social bonding between a robot and a human [49–51]. Unlike the future concerns for human-like AI, social robots already present anthropomorphization concerns for the ethicists today. Humanization of robots can result in more positive attitudes towards robots, but also creates an unrealistic perception of robot capabilities [52]. It would be up to policymakers to weigh the pros and cons of robot humanization and decide whether regulation of robot design and social programming should be implemented.

If AI evolves to the point of human intelligence, it is also possible that robots will develop a capability of deception [53]. Ethics of deception in human behavior are widely debated, so incorporation of deception for robots presents a similar ethical challenge. The most common view of deception is that it is wrong to mislead others, especially for personal gain, but it might be acceptable to lie for a "greater good" [54]. If robots were to follow that rule of thumb, roboticists would have to define situations in which deception would be acceptable. In this case, the same moral and ethical standards extend from humans to robots. There are, however, some robot-specific forms of deception that cause special concern for robotics researchers. Dishonest anthropomorphism refers to robots using deceptive signals to conceal a capacity it possesses, or to suggest that is has a capacity that it does not possess [55]. For example, a social robot could overt it's "gaze" pretending that it does not see a human when in fact it is recording via a hidden camera [56]. Regulatory policies would need to take into account robots' deception ability and formulate rules for public awareness.

3.3 Autonomy

Autonomy refers to a robot's ability to perform operations and adapt to changes independently from humans. Balancing robot autonomy and human control is one of the core challenges in robotics from both ethical and technical perspectives [57]. This challenge is applicable for all types of robots, and the expectation is that robots should behave autonomously while performing both technical and social tasks [57]. Robots can be assessed based on the amount of autonomy they possess. Several scales have been created to assess autonomy levels in different kinds of robots. For example, Attanasio et. al. have ranked autonomy of surgical robots from 0 to 5, where 0 refers to robotic systems fully operated by the human surgeon, and 5 referring to systems that can perform surgery with no human input [58]. There

are currently no surgical robots operating at Level 5 of Autonomy, but there are systems that operate at Level 4. This type of a surgical robot can interpret operative information, devise an action plan, adjust, and execute the plan while operating autonomously under surgeon's supervision [58, 59]. Higher levels of autonomy also bring up questions about moral responsibility and accountability. If a robot has an ability to make decisions, would the robot also be responsible for the consequences? This is an especially important question in the context of policy and legislation. There are currently several cases in court where Tesla self-driving cars were involved in accidents where people died [60, 61]. These lawsuits might be critical in establishing precedent for accountability policies in autonomous robotics.

Robot's level of autonomy influences how much humans trust robots. This is especially the case for robots that operate in human-rich environments, such as social robots and medical robots. A study surveying public's opinion on surgical robots found that 69% of responders felt very uncomfortable about robots performing surgery without direct control from a surgeon [62]. Another study found that non-physicians were more likely to choose robotic surgery compared to physicians [63]. Since we can expect robots and humans to co-exist and collaborate, fostering trust for autonomous robots would be fundamental to their ability to perform their tasks. Policymakers will need to be cognizant of public's perspectives and implement effective strategies in launching human–robot co-working arrangements [64].

The above sections suggest certain scenarios, factors, and concerns to consider surrounding the use of robotics in society. Implementation of robotics will have far-reaching effects on the future society. Diversity in robot functions, capabilities, and autonomy complicates the creation of a unified set of rules. However, the use of robotics may pose risks to different groups of individuals, and it is essential that the appropriate stakeholder is held responsible in harmful situations. Ultimately, the extent of ethical concern is informed by the human–robot interactions a particular robot can produce. Criteria like robot functionality, capability, contact with humans, and requirement for social skills may be taken into consideration in evaluating the ethics of human–robot interactions, and by extension the robot itself [65]. Public's safety depends on policy and legislation, so it is critical that policymakers recognize ethical implications of individual human–robot interactions and effects robots have on society overall when creating policies to govern robotics. It should also be noted that we as humans create, use, and govern robots, which means that roboethics and robot regulation depend on ethical humans to create and uphold these frameworks.

4 Roboethics and AI policies in North America and Europe

Creation of the regulatory framework for robotics is a lengthy multi-step process. Identification and distribution of ethical principles is the first step in creating relevant policy to govern the robotics field. A variety of organizations around the world has come up with their version of principles for ethical robotics. Governments and global organizations take these principles under advisement to create policies, thus translating best-practice suggestions into legislation. However, ethical guidelines often stay on as principles, thus creating an attractive loophole for companies to avoid regulation and legal persecution [66]. In cases where institutions integrate ethics into their mandate, it serves only as a marketing strategy and not a binding agreement [67]. One of the biggest gaps in AI and robotics ethical frameworks is the strict regulatory aspect. The next section examines the state of roboethics regulatory policies as proposed by international governing organizations, and North American and European governments. The policies discussed include executive orders, resolutions, proposals, and official reports commissioned by governmental agencies. Further, we have decided to include both AI and robotics policies in this overview. There are significant similarities in the ethics of robotics and AI, especially if we view robots as embodied AI [6]. The governments have also dedicated more attention to regulation of AI, most likely because AI technology is being actively incorporated in all aspects of life. It is also possible that as technology develops the line between robotics and AI will blur to the point that the distinction will be not important for the purposes of law [68]. It should be also noted that robotics technology is advancing faster than regulatory policies, so laws approved today may need to be changed in the future to reflect the state of the field of robotics [69, 70]. The latter concern also reflects on the changing and philosophical nature of ethics, where creating long lasting laws might be a challenge.

4.1 European roboethics principles, policies and legislation

European policies for robotics are initiated by the European Parliament, the European Commission and by individual governments in the EU (also referred to as Member States). Given the trade and research partnerships that exist between European countries, legislation set out by the European Parliament and the European Commission has the most power to direct the field of

robotics in Europe. Following this, the review focuses on the roboethics and AI principles set up by the European Parliament and Commission. Detailed descriptions for robotics and AI policies from individual countries can be found elsewhere [71, 72].

4.1.1 European ethical framework for robotics

A study commissioned by the European Parliament Legal Affairs Committee on European civil law in robotics proposed a general ethical framework to be followed in future legislation by the Parliament. The framework focuses on roboethical principles that would protect humans from robots and covers concepts of safety, liberty, privacy, deception, and equality [73]. The 2017 resolution of the European Parliament on the civil law rules on robotics and AI prioritized six main areas for EU legislative efforts: ethics, liability, intellectual property and flow of data, standardization, employment and institutional coordination and oversight [74, 75]. Additionally, the 2017 resolution included recommendations for a code of conduct for robotics scientists, where the role of ethical design and responsible research was recognized [75].

In a later statement published in 2018, the European Group on Ethics in Science and New Technologies listed roboethics principles that align with the current EU Treaties and the EU Charter of Fundamental Rights [76]. These principles are summarized below:

- *Human dignity* Autonomous technologies must not violate the inherent human right to be respected.
- *Autonomy* Humans are free to live to by their own standards, and humans are responsible to exert control over autonomous technologies. Autonomous technologies must not impair human freedom, responsibility, and control.
- *Responsibility* The development and use of autonomous technologies must benefit society and the environment on a global scale. Such benefits must be defined by democratic means.
- *Justice, equity, and solidarity* Regulators and practitioners must prevent or neutralize discriminatory datasets from training AI systems. AI should further efforts in global justice and equality. All humans should benefit from autonomous technologies.
- *Democracy* The regulation of autonomous technologies must result from democratic, public debate, and engagement.
- *Rule of law and accountability* Regulation of autonomous technologies must uphold all human rights standards, such as protections for safety and privacy. These protections rely on rule of law, access to justice, the right to redress, and the right to a fair trial.
- *Security, safety, and bodily and mental integrity* Safe autonomous systems promote external, internal, and emotional safety. External safety protects environments and users. Internal safety ensures consistent performance and protects against hacking. Emotional safety protects users from exploitation and abuse when interacting with autonomous machines.
- *Data protection and privacy* Digital communication technologies employ autonomous technologies to amass and store vast quantities of users' personal data. Therefore, autonomous technologies challenge protections on personal information and privacy.
- *Sustainability* Autonomous technologies must align with our human responsibility to protect our planet's ability to support life, to preserve the continued quality of the environment, and to maintain the prosperity of our species.

The roboethics principles, as defined by the European Commission in 2018, are further supplemented by the resolution on the European industrial policy on AI and robotics that was published in 2019 by the European Parliament [46]. The resolution recognizes the role of ethics in robotics and AI regulation and specifically focuses on four aspects of the roboethical framework: 1) human-centric technology; 2) embedded values in technology; 3) decision-making, and 4) transparency, bias and explainability of algorithms [46].

European commitment to ethical AI and robotics has since been re-confirmed by Ursula von der Leyen, the President-Elect of the European Commission. Her agenda for Europe specifically includes creation of standards for new generation of technologies and legislation for coordinated action on AI [77].

4.1.2 European Policies for Ethical Robotics and AI

European policy may be viewed from both national and international perspectives. Countries in the EU are free to set their own rules, but are also required to follow policy set out by the European Parliament and European Commission. In fact, current opinion of the European Union is that in term of ethical regulation for robotics and AI, there is a need for coordinated action between EU member states and the European Commission [74]. In order to create relevant policy, the EU has conducted thorough studies that informed the policymakers on current perspectives of stakeholders. This section summarizes these efforts and lays out key aspects of existing robotics regulatory framework in Europe.

4.1.2.1 Robolaw project In 2012 the EU initiated a collaborative project RoboLaw to investigate how emerging

technologies will challenge European legal systems and to survey the state of the existing robotics regulation [78]. The project produced a report with recommendations for the European Commission on regulating robotics and related technologies [78, 79]. The report details two approaches to robotics legislation: 1) creation of new laws to accommodate the new technology and 2) adaptation of existing laws to reflect technology developments. In view of the scope of the robotics field, the authors argue that both approaches might need to be employed by policymakers [79]. To investigate this question further, RoboLaw authors chose a case-study approach where they profiled four specific robot types: self-driving cars, computer-integrated surgical systems, robotic prosthesis, and care robots [78]. This approach was especially effective in prioritizing human rights and identifying unique concerns that could be missed if a broader approach was employed. Further, while each type of a robot does present a unique legislative challenge, the authors were able to deduce common themes, such as liability, on which policymakers could act. Overall, the RoboLaw project has created a foundation for robotics regulation in the EU and promoted developments in the European legislature to accommodate robotics and AI regulation.

4.1.2.2 European regulatory framework for ethical robotics and AI EU and its members already possess a rich legislative framework that is capable of accommodating some of the roboethical principles outlined above. However, both the European Parliament and the European Commission, highlight the need for further evaluation of emerging technologies and acknowledge that current legal framework is not sufficient to address all challenges posed by robotics and AI [75]. The SIENNA Project, an EU initiative aimed at understanding of ethical and human rights challenges posed by new technologies, generated a report that maps existing EU legislation to key legal issues in robotics and AI [80]. Issues of safety, liability, privacy, and equity are amongst the most well-defined by the current laws [80, 81]. Other ethical concerns for robotics, such as legal personhood for advanced AI systems, currently don't have any existing legal framework. The latter is understandable given that AI has not reached that level of advance, but even for ethical issues that do have legal coverage, existing laws are not always specific to robotics. For example, product safety is extensively covered through Directive 2001/95/EC on general product safety and Regulation (EC) No 765/2008 on market surveillance [82, 83]. These regulations were written more than 10 years ago and do not reflect on developments in digital technologies: issues such as connectivity, autonomy, algorithmic opacity, and data dependency are not explicitly discussed in the current legal product safety framework [81]. An additional challenge is presented by the variety of new technologies, where certain types of robots will need to be covered under additional legal frameworks. For example, transportation robots could be regulated though regulations such as Regulation (EU) 2018/858 on approval and surveillance of motor vehicles [73, 84].

An alternative way to regulate AI was recently proposed by the European Commission: Proposal COM(2021)206 for harmonized rules on AI develops a legal framework based on risk-levels for AI systems [85]. This approach received positive feedback during an online public consultation with European stakeholders [86]. Higher assessed risk of an AI system would mean more stringent regulation from the EU and the member states. AI systems categorized as high risk included algorithms for education, law enforcement, and worker management [87]. A similar approach can be applied to robotics, especially in systems where AI and robotics converge into a single system. Evaluating a robot based on its functionality, capability, and autonomy can inform how much risk it poses to humans, and how it should be regulated. Risk-based regulation has several advantages over the traditional legal framework: 1) flexibility; 2) proportionality; 3) complementarity and consistency with the current legislation. It is the opinion of the European Commission that if risk-based framework is adopted by EU and the Member States, it will allow for innovation while ensuring respect for existing laws and values [85].

4.1.2.3 Ethical regulation of research and innovation Research and innovation comprise one of the main focuses in the EU strategy for sustainable growth and prosperity. Responsible Research and Innovation (RRI) is a new governance model proposed by the EU that puts emphasis on co-creation and co-production with society [88, 89]. RRI framework has three main features:

1. Emphasis on science for society, where research efforts are focused on the "right impacts";
2. Development of mechanisms for reflection and inclusion, where research goals are achieved ethically, inclusively, and democratically; and
3. Responsibility, where RRI framework is applicable not only for researchers, but also entrepreneurs, policymakers, funding organizations, etc. [90, 91].

When considering the implementation of the RRI, the European Commission identified four main options that ranged from a "business as usual" option (no further action required), to legally binding initiatives on that would promote RRI coordination between the EU member states [92]. To date, the EU has implemented several policies

that reflect on RRI principles and launched numerous RRI projects via the Horizon 2020 program [93].

The Horizon 2020 program has funded €80 billion worth of projects, which include research initiatives, societal profiling for identification of unique challenges, and educational programs [93, 94]. One of the most powerful ways to regulate research is by controlling funding. To receive funding from the Horizon 2020, Digital Europe, or European Defense Fund programs, an applicant must complete an ethics self-assessment if their proposed research is in areas with high ethical risk [95]. The self-assessment helps applicants ensure that their research will comply with applicable international, EU and national law, and also facilitates grant review with regard to responsible implementation and social acceptance [95]. Importantly, completion of the self-assessment is a part of one's grant agreement and imposes binding obligations that may be verified through official channels. For artificial intelligence, and by extension robotics, the assessment relies on the guidelines proposed by the High-Level Expert Group on AI [96, 97]. To be approved for funding, the project must follow key prerequisites for ethically sounds AI:

1. Human agency and oversight,
2. Technical robustness and safety,
3. Privacy and data governance,
4. Transparency,
5. Diversity, non-discrimination and fairness,
6. Societal and environmental wellbeing, and
7. Accountability [97].

Apart from the above prerequisites, grant applicants are invited to consider how their AI system may be used, and whether it can be utilized in especially dangerous manner, for example in weapon systems [95].

The EU has developed a robust multi-project framework to support their RRI efforts and conducted case-studies to understand best implementation strategies across EU Member States. One of the deliverables includes a handbook for organizations aimed at strengthening responsible research and innovation [98]. The handbook can be utilized by academic institutions to foster RRI among engineers-in-training, this creating professionals that would follow the EU directive for ethical by design robotic systems [99]. The diversity and expanse of RRI initiatives is likely to facilitate ethical implementation of robotics and AI in EU.

It is evident that Europe is currently actively implementing roboethics principles into policy. Europe's approach to policymaking is characterized by thorough research, extensive survey of all stakeholders, and prioritization of common goals of growth, innovation, and sustainability. European governing bodies are aware of the weaknesses of the existing legislation and have created a comprehensive list of enhancements that would bring legal frameworks for robotics and AI to the next level [100]. Overall, the EU's commitment to democratic policymaking fosters close relationships between industry, academia, and government, which creates a collaborative environment for relevant policymaking.

4.2 North American policies for ethical robotics and AI

America has the least number of robot units sold or shipped as compared to Europe and Asia [101]. This difference can be explained by a variety of factors such as economic policy, cultural climate, funding for innovation, and regulatory framework. Unlike Europe, North America does not have a unified governance system, so this section will explore roboethics principles and policies in the United States of America and Canada. Both countries represent unique governance frameworks that significantly differ from the European legislative system. In both the U.S. and Canada, federal laws are supplemented by state and province legislation, thus complicating the creation of a unified regulatory framework for robotics. Additionally, the Canadian and American common law systems rely heavily on precedent setting case law, where regulation is created based on precedents; this is especially troubling for emerging technologies such as AI and robotics because ethical issues might not be immediately brought up in the court system. There are also cultural differences between Europe and North America- where the EU places a lot of emphasis on sustainable growth, stakeholder engagement, and democracy, the U.S. is heavily focused on productivity and economic growth [102]. As such, there is a paucity of government-set ethical frameworks for AI and robotics. Here we discuss the existing regulatory and ethical frameworks for robotics and AI in North America.

4.2.1 American ethical frameworks for robotics and AI

U.S. interest in AI and robotics leadership is evident: several executive orders, memorandums, reports, and strategies from the Office of the President outline U.S. national goals for AI development and leadership [102–105]. The National Science and Technology Council has published a strategic plan for AI research, where the Council recommends development of a framework that would support effective AI innovation and ethical implementation [106]. The U.S. Congress has also passed the National Artificial Intelligence Initiative Act of 2020 which established the National AI Initiative to help coordinate AI-related activities across U.S. Departments and Agencies [107]. On February 11, 2019 President Trump signed an executive order

which presents five principles for the American AI Initiative. These principles reflect on several core themes:

1. Commitment to AI development and implementation to support economic competitiveness and national security;
2. Creation of technical standards for AI deployment and adaptation;
3. Education of the public to help people develop skills necessary in the future (when AI will become more prominent);
4. Fostering of public trust and confidence in AI technologies and protection of civil liberties, privacy, and American values;
5. Creation of international environment that would support American AI industries [104].

These principles reflect on core ethical values of safety and trust, but don't provide enough detail to be read as regulatory policy. The majority of specific ethical principles and frameworks are released by individual departments, such as the Department of Defense (DOD), the Department of Transportation (DOT), and the Department of Health and Human Services (HHS) [108–110]. The former has published five qualities of ethical AI, which are aimed to supplement existing U.S. military ethical framework [108]. These qualities are as follows: responsible, equitable, traceable, reliable, and governable. DOT has taken a less structured approach but has also demonstrated commitment to ethical regulation in their report on the future of automated vehicles. The report lists key concerns that DOT has identified though stakeholder engagement, many of which overlap with ethical concerns for robotics and AI [109]. Overall, the U.S. currently does not have a unified government-presented ethical framework for AI and even less so for robotics.

In the current system, it is up to individual departments, institutions, and industries to evaluate ethics of their activities and devise an ethical framework to be followed. There are several notable examples where a non-governmental institution has created an ethical framework that later got widely adopted. The Future of Life Institute has created 23 Asilomar Principles which reflect on research, ethics and values, and long-term issues for AI [111]. The Asilomar Principles have gathered a large following in the field and have been signed by over 1500 AI/robotics researchers. Further, the California Office of Legislative Council has passed a resolution in support of the Asilomar Principles [112]. Another example comes from Partnership on AI, a consortium founded by Amazon, Facebook, Google, Microsoft, Apple, and other technology executives [113, 114]. They have created a list of tenets that promote research, discussion, education, understanding, and leadership in the development and use of AI technologies. Per one of the tenets, the Partnership's members are supposed to "ensure that AI technology is robust, reliable, trustworthy, and operates within secure constraints" and "promote safeguards and technologies that do no harm" [114]. In contrast to this tenet, Apple is currently preparing to implement a non-voluntary AI algorithm to scan for images of child sexual abuse on iOS devices, thus implementing an AI with major risks and creating a precedent for privacy violation on a world-wide scale [115, 116]. This last example illustrates a major weakness of a privately set ethical framework that is not supported on a government level.

4.2.2 Canadian ethical frameworks for robotics and AI

Over the last decade the Canada has demonstrated an interest in becoming a global leader for AI. To reach this goal, the Canadian government has established several programs to support ethical AI development and deployment. In 2017 the Canadian government committed $125 million for a pan-Canadian Artificial Intelligence Strategy, the objective of which is to attract world-class AI talent, foster a collaborative AI ecosystem, and understand the societal implications of AI [117]. Since its launch, the AI Strategy has resulted in increased AI skills migration, a 200% increase in the number of publications from AI institutes, and a 49% boost in investor funding for AI projects [118, 119]. While the Canadian Institute for Advanced Research (CIFAR) was developing the AI strategy, they conducted stakeholder interviews, which included workshops and discussions with the Indigenous community. In collaboration with the Initiative for Indigenous Futures, CIFAR has released a position paper that discusses guidelines for Indigenous-centered AI design. Notably, the paper specifies that while these guidelines were developed with Indigenous community, they are applicable in any context where AI development and implementation is considered [120]. Some of the guidelines listed are similar to ones proposed in other ethical guidelines for AI and robotics (e.g. data management, ethical design, need for governance guidelines, responsibility and accountability), but there are some notable differences. Specifically, guidelines for locality, relationality and reciprocity, and recognition of the cultural nature present valuable additions to traditional ethical frameworks. Recognition of cultural differences and locality of AI applications will have significant influence of the future of robotics and AI once these technologies become globally widespread.

The Canadian government has recognized the opportunities that AI and digital technologies present for the future of governance. The Digital Government program lists five guiding principles to ensure effective and ethical

use of AI [121]. Under these principles, the government will.

1. Understand and measure the impact of AI,
2. Be transparent about how and when AI is being used,
3. Provide explanations on AI decision making,
4. Be transparent about sharing technical details, and
5. Provide sufficient training on the use of AI solutions [121].

Further, the Government of Canada has launched an international collaboration with France to guide responsible adoption of AI worldwide through the International Panel on Artificial Intelligence (IPAI) [122]. The goal of IPAI is to conduct analysis to guide AI policy development grounded in human rights, which will be achieved through production of reports and assessments. This collaboration is a promising step to creation of universal ethical frameworks for AI.

Outside of governmental efforts to create ethical guidelines for AI and robotics, Canadian academic institutions and non-profits have made significant contributions to the field. The University of Montreal proposed the Montreal Declaration for Responsible Development of Artificial Intelligence, which has been signed by 192 organizations and 2300 citizens [123]. The Declaration lists 10 principles for ethical AI and provides recommendations for development of public policies on AI [124]. The Canadian Robotics and AI Ethical Design Lab (CRAiEDL), based from the University of Ottawa, has explored roboethics of healthcare, social robots, automated vehicles and weapons [125]. The works of CRAiEDL members have been published in academic journals and further propagated through stakeholder presentations. The group has also created ethical design tools for robotics and AI, which provide practical techniques to empower engineers to engage in the ethical-by-design process [126]. The Open Roboethics Institute (ORI), a nonprofit think tank from Vancouver, has also created an AI Ethics Assessment Toolkit that walks organizations and individuals though a step-by-step process for design of impactful technologies that are aligned with shared values of the society [127].

Compared to the U.S. ethical frameworks, the Canadian system is similarly lacking in terms of robust federal initiatives for ethical AI and robotics. A report published by the University of Montreal stresses that current interconnection between government, industry, and academia largely benefits private interests [128]. Currently private AI companies receive funding from the Canadian government while following internal ethics frameworks, and what is more worrisome is that companies that have been linked to human rights abuses are allowed to become vendors with the government [128–130]. Overall, the combined work of CIFAR, academic institutions, and non-profit think tanks creates a solid foundation for creation of much-needed governmental policies on robotics and AI.

4.2.3 American regulatory framework for ethical robotics and AI

Currently there is no single governmental body responsible for AI and Robotics regulation although creation of a Federal Robotics Commission has been proposed [131]. As a result, current policy and legislature on robotics and AI in the U.S. has been fragmented and generally falls under one of these categories: federal and state law, case law, and technical standards.

On the Constitutional level, there have not yet been any amendments to reflect on the impact robotics and AI have had. The Fourth Amendment protecting citizens from unreasonable search may be in the biggest need for revision due to incorporation of AI-directed risk-assessment tools and robotics in law enforcement [132–134]. If robots reach an independent status, the First Amendment would also need to be revised to include AI-generated speech [135]. The existing legislation is primarily focused on specific applications of robotics and AI such as unmanned aircrafts, self-driving vehicles, algorithms for data collection and assessment, and facial recognition technology [136]. From the roboethics perspective, most of these policies reflect on the principles of privacy, accountability, and transparency [137]. The U.S. Congress has a few bills awaiting enactment, such as the Algorithmic Accountability Act which would require companies to conduct risk-assessment on automated decision systems based on their "accuracy, fairness, bias, dis- crimination, privacy, and security" [138]. If passed, the bill will regulate AI across industries and will be enforced by the Federal Trade Commission [137, 138]. In addition to robot-specific laws, there are also laws that apply to robots by extension, such as regulations on product safety, and by extension manufacturer liability [139, 140]. There are also regulations for safe use of robots in the workplace: Occupational Safety and Health Administration has created its guidelines for robotics safety in 1987 [141]. These guidelines will need to be adapted to reflect technological development, societal changes, and current workforce expectations [142].

Wide implementation of AI and robotics in society has produced several legal precedents in the U.S. courts. Undoubtedly the number of cases involving AI and robots will continue to rise, so laws and court decisions made now will have long-lasting effects in the future of robotics case law. Ryan Calo has separated existing cases based on the role a robot plays in the trial— is the robot an object or a subject of the judiciary system [143]. If a robot is designated as an object, then is acts as an artifact

in a human world, e.g. a surgical robot being manipulated by a surgeon results in an unfavorable patient outcome [143, 144]. In this type of case-law, liability assessment presents a major challenge. One of the first influential cases on AI and liability comes from 1949 case Brouse v. United States, where the court decided that the pilot has to keep a proper and constant lookout even if the plane is controlled via an autopilot [145]. The same case can be viewed from the autonomy perspective— in this case the autopilot was not capable of detecting sudden changes and making autonomous decisions to change flight direction. The courts have also tried cases pertaining to algorithm transparency: in State v Loomis, the court decided that use of a risk-assessment software for sentencing did not violate rights of the accused, even though the algorithm specifics were not disclosed [146, 147].

In Calo's case law framework, if a robot is designated as a subject, it only appears in the imagination of the judge [143]. While not as applicable to robotics regulation, perception of robots shapes future rights of robots. Currently robots are largely viewed as tools, impartial and inanimate objects, incapable of independent action [143, 148, 149]. As a result, there have been cases where humans were compared to robots, and assigned robot-like characteristics. If the judicial system adjusts its perception of robots to more independent machines, the robot analogy would be unusable, which would alter the outcome for the cases in question. The perception of robots and AI by humans will also ultimately affect the rights of autonomous systems. It is conceivable that future AI will reach human-like capabilities, but even in the current day AI systems are capable of creation. A unique case was recently heard by the District Court of Virginia, where an AI engineer had sued the U.S. Patent Office for declining two patents that he had submitted on the behalf of the AI system, which he designated as an inventor on the patent documents [150, 151]. The court has sided with the U.S. Patent Office and ruled that AI cannot be an inventor [151]. This ruling will undoubtedly affect how the work of AI, especially in terms of ownership, will be perceived in future court cases. Overall, the court system may expect to face a difficult task of deciding on robotics cases in a rapidly changing technological and legislative environments.

Technical standards can be used by industries to ensure that all products meet a pre-set benchmark and thus provide another layer of regulation for AI and robotics. Institute of Electrical and Electronics Engineers was founded initially as a U.S. professional organization but has since grown internationally to include over 420,000 members across 160 countries [152]. IEEE has previously published guidelines on ethical AI development, and in 2016 IEEE pioneered a new set of technical standards that prioritizes ethical considerations in the design and manufacture of robotics and AI [153, 154]. The P7000 family of standards could be helpful in assisting lawmakers in designing policy that is ethical and supported by the industry [155, 156]. For example, P7001 "Transparency of Autonomous Systems" could supplement the recently introduced Algorithmic Justice and Online Platform Transparency Act and promote development of trustworthy and ethical AI [157, 158]. The Algorithmic Accountability Act could be accompanied by IEEE's P7003 on "Algorithmic Bias Considerations" [159]. IEEE has also created a framework for assessing the impact of autonomous and intelligent systems on human well-being, which is one of the very few standards that address ethical design for robotic devices [160].These standards are informative in shaping government policy, and if adopted could facilitate establishment of ethical robotics worldwide.

4.2.4 Canadian regulatory framework for ethical robotics and AI

While Canada was one of the first countries to advocate for creation of a federal AI strategy, there haven't been similar advances in legislative framework for AI and robotics. Similar to the U.S. and EU, some of the existing Canadian federal and provincial laws can be applied to automated systems. Specifically, Consumer Product Safety Act, Motor Vehicle Safety Act, Privacy Act, and Personal Information Protection and Electronic Documents Act can be of use where user safety, privacy, and data rights are in question [161–164]. The Canadian government has recognized the potential of digital technologies for the services that it provides and can be seen as an active user of AI and robotics. To ensure that these technologies are developed and used ethically, the Treasury Board has released a Policy on Service and Digital to document requirements for privacy, official languages and accessibility, management of service delivery, information management and cyber security in the Canadian government [165]. The policy includes several key directives that dictate the ethical use of AI for government. The Directive on Automated Decision Making addresses the use of AI to make administrative decisions and outlines a process that ensures that AI is being used in a manner that is "compatible with core administrative law principles such as transparency, accountability, legality, and procedural fairness" [166]. One of the key requirements in the Directive is mandatory completion of an Algorithmic Impact Assessment, a questionnaire that is composed of 48 risk and 33 mitigation questions [167]. The questions direct a comprehensive analysis of an AI system, starting from which motivation for the algorithm implementation, and ending with strategies for unbiased data representation. Based on the assessment, an algorithm is assigned an impact level that would inform the

stakeholders on the next steps for the algorithm implementation. While the Policy on Service and Digital is currently only used for government projects, it covers ethical principles and practical considerations that are relevant to implementation of any automated system. As such, it could potentially become a general federal policy for AI development and regulation.

In absence of an existing legal framework, companies may resort to signing of detailed contracts with their customers. The contract would then detail company responsibilities, liabilities, and overall serve as a legislative proxy [168]. However, this approach places the responsibility on the consumer to understand the contract and the consequences of signing. The contractual system would not prohibit the company from including unethical clauses, and thus would overall not benefit sustainable and ethical AI or robotics implementation in Canada.

4.3 International policies for ethical robotics and AI

Robotics and AI are relatively new technologies with a great potential; in fact, both belong to a class of technologies that are referred to as "disruptive" for the scale of change they can trigger. Because of that, international organizations have also weighed in on ethical considerations and regulations for AI and robotics. Organizations like the United Nations (UN), the World Bank, and Organization for Economic Co-operation and Development (OECD) have all contributed to the field of AI and robotics by conducting studies and publishing reports that reflect on ethics of these technologies [169–171]. The ethical frameworks and principles identified by the international organizations are of advisory nature and cannot be enforced, but they can serve as a starting point for individual governments to create their own AI and robotics strategies. In other words, there are currently no international policies for ethical AI and robotics. However, international policy might be of the most importance considering the impact and international commercialization of robots and AI. If robots and AI are to be shipped and implemented around the world, a global policy could ensure that they are being used safely and ethically.

While there is no international policy for robotics and AI, there is one particular application of these technologies that might receive international regulation soon. Lethal Autonomous Weapon Systems (LAWS), or so-called "killer robots", are a cause of active debates held primarily at the UN Convention on Certain Conventional Weapons (CCW) [172]. The purpose of the CCW meetings is to restrict the use of weapons which would cause unjustifiable suffering [173]. During the CCW meetings the member states have acknowledged that LAWS fall under the purview of the International Humanitarian Law but view on the LAWS regulation have been divided. Academics and organizations like the Human Rights Watch have been calling for an international ban on LAWS, but when a preemptive ban on LAWS was proposed at the CCW, it received opposition from countries like Germany, the U.S. and Russia [172, 174, 175]. An outright international ban on LAWS is unlikely to be accepted, so instead a "Killer Robot Treaty" based on aligning views has been proposed [176]. According to the CCW meetings, most States supported the creation of a legally binding regulation for LAWS with specific emphasis on maintenance of human control [176, 177]. Lately the Human Rights Watch has been urging the governments to move from the discussion stage to the policy-writing stage and citing that a number of powerful countries have already been developing LAWS. For countries that are already engaged in LAWS development, the worry is also that their weapons review mechanisms differ greatly, which could lead to production of LAWS whose safety and robustness are not up to standards set out by the CCW [178]. International regulation of LAWS is likely to happen in the near future.

Unfortunately, international regulation of non-military robots does not carry the same sense of urgency. In the absence of international policy, technical standards can be used to establish a baseline level of regulation. The International Organization for Standardization (ISO) is an organization that has published almost 24,000 standards, 40 of which are addressing robotics directly [179]. Some of these standards are quite technical and specific: for example, ISO 15616–4:2008 describes specifications for laser beams used in welding robotics; other standards are based on ethical principles such as safety, equity, and privacy [180, 181]. The latter represent an intriguing opportunity to create industrial regulations based on ethical ISO standards. Without international regulation on ethical robotics and AI, they could be the next best thing to ensure that internationally traded AI and robots don't compromise users' rights to safety, equity, or privacy.

5 Discussion

This review has largely focused on roboethics and AI policies that were proposed by governments and large international advisory institutions, but other types of organizations such as universities, companies, and non-profits often put forward their own policies for ethical robotics and AI. In fact, while these policies are not binding, they often pioneer ethical concepts which then get implemented in governmental policymaking. Many organizations have published their views on ethical robotics and AI, and the ethical frameworks that emerge from these works are quite similar. A report from the Berkman Klein Center at

the Harvard University analyzed 36 documents on ethical AI and has identified eight common themes:

1. Privacy,
2. Accountability,
3. Safety and Security,
4. Transparency and Explainability,
5. Fairness and Non-discrimination,
6. Human Control of Technology,
7. Professional Responsibility, and
8. Promotion of Human Values [182].

Authors have also noted that most recent works on ethical AI have covered all the above themes, which suggests that institutions are aware of key ethical concerns, and that the discourse on the ethics for AI has reached a point of saturation. There are, however, aspects of these themes that have received less coverage in reports on AI principles: the right for data erasure was only covered in 6% of the surveyed works, and only 8% of reports mentioned the ability to opt out of automated decisions [182]. A report by Thilo Hagendorff has also found that issues of certification of AI products and cultural differences for ethical AI systems have received the least attention in the 22 reports that he has surveyed [67]. Altogether, this suggests that the field of ethical AI and robotics is ready to transition from the research stage to the implementation stage. This opinion is further supported by the desire of AI and robotics corporations for guidance on managing of risks that arise from adoption of disruptive technologies [171]. Since the industry is moving faster than the regulators, the International Finance Corporation has developed a Technology Code of Conduct and implementation tools to be used in place of regulatory directives. The Technology Code of Conduct is based on existing ethical frameworks and includes practical steps to ensuring that new technologies support public trust and sustainable innovation [171]. This effort on behalf of the International Finance Corporation demonstrates a trend for technological self-regulation which arose because governments are slow to create their own regulatory standards.

As of 2021, AI and robotics regulation by governmental institutions appears to be at its infancy. Among the regions discussed in this review, Europe has the most rounded approach to AI policies and appears the most prepared to launch full-scale regulation of robotics and AI [4]. The European Commission has committed the most resources to establishment of ethical frameworks and has conducted extensive stakeholder surveys to ensure that proposed regulation is relevant and equitable. The EU has also created a plan for further legislation and a way to address AI and robotics systems based on the risk they carry. Further, EU grants have implemented surveys to ensure that EU-funded technologies are aligned with the developed ethical frameworks for impact assessment. Overall, EU policies for AI and robotics are largely based on public opinions and already contain specific guidance on how the policies are to be implemented.

In North America, the Canadian framework for AI and robotics regulation seems to be more promising. The fact that the Canadian government has already launched laws for regulation of AI within governmental systems signifies its commitment to ethical AI regulation. Additionally, these laws can be expanded to create federal regulation for AI and robotics. The U.S. is currently in the information-collection stage of creating federal AI regulation, which allows for companies like Apple and Facebook to implement high-risk AI systems. Further, there are concerns for whom the U.S. calls "AI experts"- Joichi Ito, who led the MIT media lab and consulted on the ethics of AI, has been revealed to have ties with Jeffrey Epstein, and contributed to Silicon Valley's efforts to avoid legally enforceable restrictions [66]. For both the U.S. and Canada the existence of case law complicates the regulation of AI and robotics. In cases where decisions are made prior to adoption of federal regulations on AI and robotics, the precedent created could surpass the federal law.

Ultimately, the uptake and implementation of AI and robotics regulation may require research, time, and investment. Both Europe and North America have created ethical frameworks for AI and robotics, and it is now time to transform ethical principles from theory to practice. The following action-steps may be taken by government structures to promote robotics and AI regulation worldwide:

1. Establishment of policies and regulations that enforce roboethics policies;
2. Alignment of funding program's guidelines with ethical principles;
3. Reform of postsecondary robotics and AI degree programs to include ethical requirements;
4. Establishment of national and international agreements for ethical robotic research, development, and deployment.

The importance of regulation for AI and robotics cannot be overstated: the safety and wellbeing of every member of society depends on responsible use of these disruptive technologies. It is now up to policymakers to ensure that grim predictions of George Orwell and Karel Capek don't come to life.

6 Conclusions

Our work summarizes current governmental initiatives in EU, U.S., and Canada to regulate AI and robotics to ensure that new technologies are developed and used in accordance with existing ethical guidelines. In general, policies are built through comprehensive analysis of ethical considerations pertaining to a technology (for example, by considering function, capability, and autonomy categories as outlined in Sect. 3). Governments and organizations have also implemented risk-and impact-assessment tools to facilitate policy adaptation for each robotics case. This process is outlined in Fig. 1. Current ethical frameworks set up by both European and North American governments are being actively translated into enforceable policy, where stakeholders like academic researchers, software engineers, entrepreneurs, and policymakers are collaborating to create a set of regulations that would ensure sustainable innovation and human wellbeing. While neither Europe or North America have a complete regulatory framework for AI and robotics yet, it is likely that that we will see big shifts in regulation of AI-based systems in the next 10 years. The progress of AI policies implemented around the globe can be tracked via the OECD Policy Observatory and through the euRobotics Topics Group "Ethical, Legal and Socio-Economic Issues" directory for policy documents [183, 184].

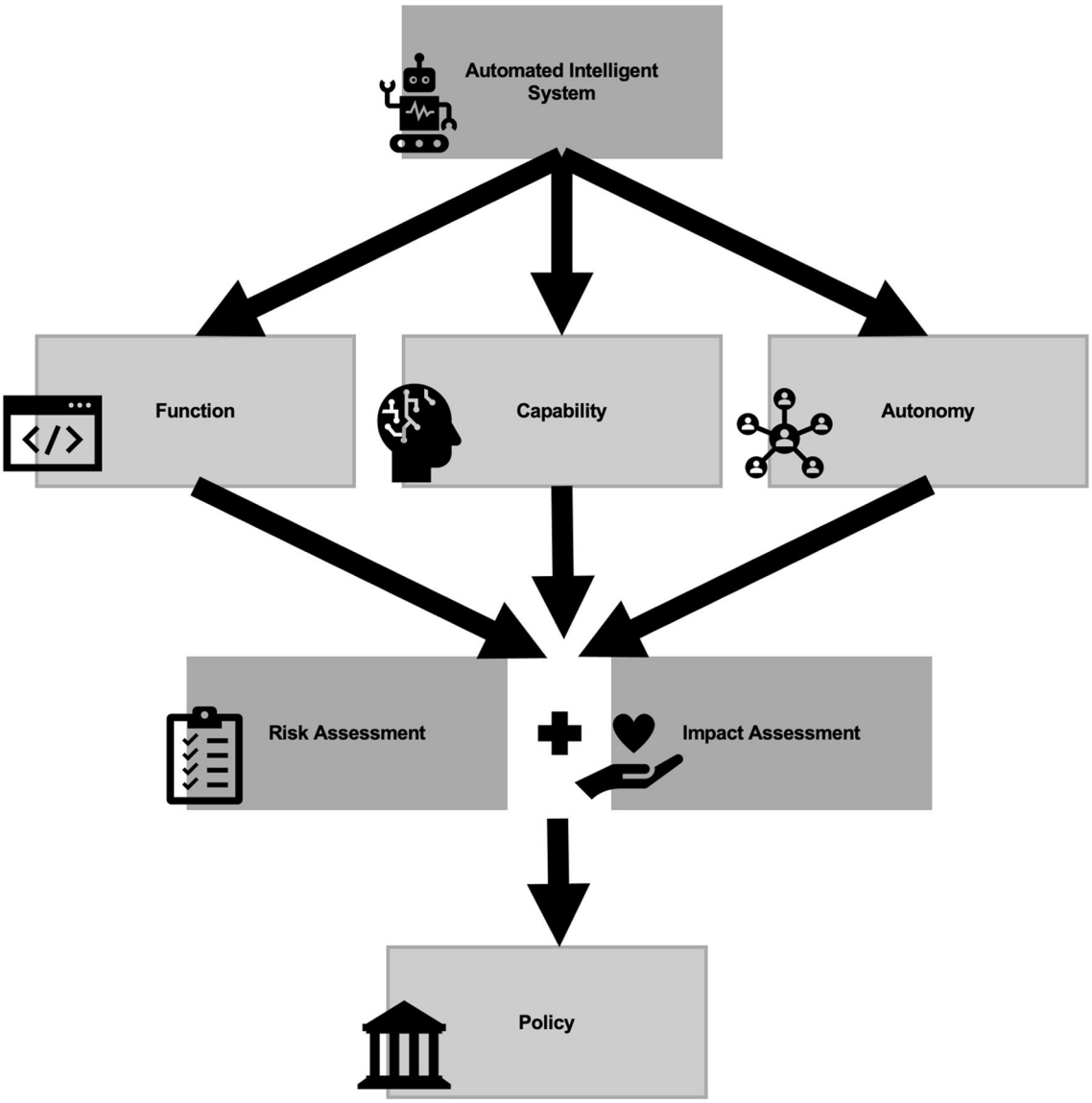

Fig. 1 A schematic representing how ethical considerations can become policy by becoming implemented in risk-assessment and impact-assessment tools

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Declarations

Conflict of interest The authors declare that there is no conflict of interest.

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Robots in American Law

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ROBOTS IN AMERICAN LAW

Ryan Calo[*]

This article closely examines a half century of case law involving robots—just in time for the technology itself to enter the mainstream. Most of the cases involving robots have never found their way into legal scholarship. And yet, taken collectively, these cases reveal much about the assumptions and limitations of our legal system. Robots blur the line between people and instrument, for instance, and faulty notions about robots lead jurists to questionable or contradictory results.

The article generates in all nine case studies. The first set highlights the role of robots as the objects of American law. Among other issues, courts have had to decide whether robots represent something "animate" for purposes of import tariffs, whether robots can "perform" as that term is understood in the context of a state tax on performance halls, and whether a salvage team "possesses" a shipwreck it visits with an unmanned submarine.

The second set of case studies focuses on robots as the subjects of judicial imagination. These examples explore the versatile, often pejorative role robots play in judicial reasoning itself. Judges need not be robots in court, for instance, or apply the law robotically. The robotic witness is not to be trusted. And people who commit crimes under the robotic control of another might avoid sanction.

Together these case studies paint a nuanced picture of the way courts think about an increasingly important technology. Themes and questions emerge that illuminate the path of robotics law and test its central claims to date. The article concludes that jurists on the whole possess poor, increasingly outdated views about robots and hence will not be well positioned to address the novel challenges they continue to pose.

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INTRODUCTION

"Robots again." So begins Judge Alex Kozinski's dissent from the Ninth Circuit's decision not to rehear *Wendt v. Host International* en banc.[1] "Robots," because *Wendt* involved animatronic versions of two popular television characters that, the actors said, violated their rights of publicity.[2] "Again," because, just a few years before, the Ninth Circuit decided *White v. Samsung*, in which Vanna White sued the electronics giant Samsung for featuring a robot version of the game show host in an advertisement.[3]

Robots appear in surprising number and variety in American law. *White* and *Wendt* are fairly well known. But most of the cases to involve robots have never made their way into legal scholarship. This article closely examines six decades of courts struggling with robots—just in time for the technology itself to enter the mainstream. This detailed examination leads to a simple thesis: robots confront courts with unique legal challenges that judges are not well positioned to address.

[1] Wendt v. Host Int'l, Inc., 197 F.3d 1284 (9th Cir. 1999) (Kozinski, J., dissenting from denial of petition for rehearing).

[2] Wendt v. Host Int'l, Inc., 125 F.3d 806, 809 (9th Cir. 1997).

[3] White v. Samsung Elec. Am, Inc., 971 F.2d 1395 (9th Cir. 1992), *cert. denied*, 508 U.S. 951 (1993).

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The challenges robots pose will only become more acute in light of the explosive growth of the robotics industry over the next decade. Today robots are leaving the factory and theatre of war and entering our roads, skies, offices, and homes. We are in the midst of a robotics revolution.[4] Popular technology companies are investing billions in robotics and artificial intelligence.[5] Patent filings for robots are skyrocketing.[6] Hardly a day goes by without a national headline devoted to driverless cars or drones.[7]

In previous work, I examined what the mainstreaming of robotics might mean for American law and legal institutions.[8] I grounded the discussion in the legal and policy fallout from the last transformative technology of our time, the Internet. The Internet has a set of core qualities that tended to pose challenges for law. For example, the Internet allows for instant exchange of goods and services across borders, which invited courts to revisit the rules of jurisdiction.[9] Robotics, I argued, has a different set of core qualities than the Internet and, accordingly, will generate new puzzles for law.[10]

Robotics and the Lessons of Cyberlaw drew several thoughtful responses.[11] Yale Law professor Jack Balkin agrees that robots will generate interesting new legal puzzles but questions whether we can know what these might be in advance.[12] Balkin observes that the only reason we can point to the legally relevant features of the Internet is that we have two

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[4] *See* Gill A. Pratt, *Is a Cambrian Explosion Coming for Robotics?*, 29 J. ECON. PERSP., 51, 51 (2015) ("Today, technological developments on several fronts are fomenting [an] explosion in the diversification and applicability of robotics.").

[5] Google, Amazon, Facebook, IBM, and many other companies are each investing millions or billions of dollars in these technologies. *See, e.g.*, John Markoff, *Google Puts Money On Robots, Using the Man Behind Android*, N.Y. TIMES, Dec. 4, 2013; John Letzing, *Amazon Adds That Robotic Touch*, WALL ST. J.., Mar. 20, 2012. Some recent investments outside of the United States are even more dramatic. *See, e.g.*, *EU launches world's largest civilian robotics programme*, EUROPEAN COMMISSION, June 3, 2014, http://europa.eu/rapid/press-release_IP-14-619_en.htm; Kelvin Chan, *China's robot revolution is happening*, ASSO. PRESS, Sep. 23, 2015.

[6] *See* "World Intellectual Property Report: Breakthrough Innovation and Economic Growth," WORLD INTELLECTUAL PROPERTY ORGANIZATION, 120-35 (2015) (discussing surge in patent and other intellectual property activity).

[7] A search of Westlaw revealed well over four thousand news stories where drones or driverless cars appeared in the headline in 2015 alone.

[8] Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 CALIF. L. REV. 513 (2015).

[9] *Id.* at 520-21.

[10] *See generally id.*

[11] For example, bestselling science fiction writer Cory Doctorow responded to the article by calling into question whether there can be any legal distinction between robots and computers. Cory Doctorow, *Why it is not possible to regulate robots*, THE GUARDIAN, Apr. 2, 2014.

[12] Jack M. Balkin, *The Path of Robotics Law*, 6 CALIF. L. REV. CIRCUIT 45, 49 (2015).

decades of experience with theorists and courts writing about cyberlaw.[13] For Balkin, we will have to wait and see what path robotics law will follow. Or perhaps look to science fiction, where the laws of robotics are familiar.[14]

Professor Balkin's helpful critique led to this article's animating question: Are we in the same place today with robotics that we found ourselves at the dawn of cyberlaw? I submit that we are not. Courts and law professors in the 1990s had very limited experience with the Internet; it was brand new.[15] Robots, in contrast, have played a role in American society since at least the 1950s. And, like most technologies, they have been involved in legal disputes. What do those disputes tell us today, as robots enter a new golden age? And how should courts and other jurists think about contemporary robotics?

We should not be surprised that American courts have had to make decisions involving robots. People have been thinking about robots for thousands of years. The sixth century manuscript *Shai Shih t'u Ching* catalogues mechanical orchestras and other automata that predate the birth of Christ.[16] Since at least the 1980s, robots have been instrumental in keeping American factories competitive.[17] In the past two decades, the United States government has embraced robotics in its effort to overhaul the most powerful military in the world.[18]

What *is* surprising is how difficult and complex these cases turn out to be, and what they wind up saying about the law itself. This article canvasses hundreds of decisions concerning robots over half a century, generating nine new case studies for the burgeoning field of robotics law. The first six consist of archetypes of a particular kind of problem that robots pose as objects. Among other issues, courts have had to decide whether robots represent something "animate" for purposes of import tariffs,[19] whether robots can "perform" as that term is understood in the context of a state tax on performance halls,[20] and whether a salvage team "possesses" a

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[13] *Id.* at 48.

[14] *Id.* at 60.

[15] *See* Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL F. 207, 207 (calling attention to legal scholars' lack of experience with the Internet).

[16] *See* Pau Alsina, *Arte*, CIENCIA, Y TECHNOLOGIA 85 (2007) (discussing the Shai Shih t'u Ching or "Book of Hydraulic Excellencies"). *See also* IBN AL-RAZZAZ AL-JAZARI, *The Book of Knowledge of Ingenious Mechanical Devices* (Donald R. Hill, trans. 1974).

[17] [cite]

[18] *See* PETER W. SINGER, WIRED FOR WAR: THE ROBOTICS REVOLUTION AND CONFLICT IN THE TWENTY-FIRST CENTURY (2009).

[19] *E.g.*, Louis Marx & Co. v. United States, 40 Cust. Ct. 610, 1958 WL 8607 (1958). *See also* infra.

[20] Comptroller of the Treasury v. Family Entertainment Center of Essex, Inc., 519 A.2d 1337 (Md. 1987). *See also infra*.

shipwreck by visiting it with an unmanned submarine.[21]

Robots also play an interesting role as the subjects of judicial imagination. The article's remaining three case studies explore the versatile, often pejorative role robots play in judicial reasoning itself. Judges need not be robots in court, for instance, or apply the law robotically.[22] The robotic witness is not to be trusted.[23] People who commit crimes under the robotic control of another might avoid sanction.[24]

Together these case studies paint a nuanced picture of the way courts think about an increasingly important technology. Themes and questions emerge that illuminate the path of robotics law and test its central claims to date. We can see already how robots begin to blur the line between people and instrument, and how faulty assumptions about robots lead jurists to questionable or contradictory results. The article concludes that jurists on the whole possess poor, increasingly outdated views about robots and hence will not be well positioned to address the novel challenges they continue to pose. A more comprehensive understanding of robotics and the diversification of sources of robotics law to include legislators and regulators may help—hopefully in enough time to a make a difference.

The article proceeds as follows. Part I discusses robots as the objects of law, i.e., as things in the world that occasion legal disputes, placing particular emphasis on the role of robots as surrogates for people.[25] We begin with *White* and *Wendt* but quickly turn to less-examined legal territory. Part II investigates the role of robots subjects in judicial reasoning, i.e., as metaphors or analogies that actually drive the decisions of courts. The concept of a robot in these cases is not a mere passing reference but a part of the central holding, an idea cited by later courts for its binding or persuasive effect. Part III unites the past of American robot law with its likely future—a crucial exercise given the rapid mainstreaming of drones, driverless cars, surgical robots, home robots, and other robotics technology. This Part examines whether past cases shed light on existing puzzles,

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[21] Columbus-America Discovery Group, Inc. v. Abandoned Vessel, S.S. Central America, 1989 A.M.C. 1955 (1989). *See also infra*.

[22] *E.g.*, Commonwealth of Williams v. Local Union 542, 388 F. Supp. 155 (1974); Allen v. State, 290 Ala. 339 (1973) ("The trial judge is a human being, not an automaton or a robot."). *See also* infra.

[23] *E.g.*, Rong Lin v. Mukasey, 299 F. App'x 10 (2d Cir. 2008). *See also* infra.

[24] *E.g.*, Frye v. Baskin, 231 S.W. 2d 630 (Mo. App. 1950). *See also* infra.

[25] Woodrow Hartzog offers this helpful term. Balkin also talks about the notion of a "substitution effect" where robots stand in for people. Balkin, *supra* note 12, at 55. In previous work, I speak in terms of the social valence of robots, i.e., the unique status of robots as an artifact that feels like an animate being. Calo, *supra* note 8, at 545-49. The tendency is so strong that soldiers have reportedly risked their lives on the battlefield to rescue a robotic member of the team. *Id.* at 515.

generates new questions for scholars including around race and gender, and discusses the role of courts, legislators, regulators, and others in setting the path of robotics law going forward. A final section concludes.

I. ROBOTS AS LEGAL OBJECTS

This Part consists of six case studies generated by an analysis of over two hundred cases involving robots and analogs. More specifically, my research assistants and I searched Westlaw for opinions that mention robots and close synonyms such as "robotics" and "automaton." For the case to be a candidate for analysis, the word could not appear merely in the body of the decision but had to appear in the syllabus or headnotes. In this way, the research attempts to filter out hundreds of other cases in which the term "robot" appears but does not meaningfully factor into the factual or legal dispute.[26]

The concept of a robot is not without controversy. In my previous work, I embrace a definition of a robot as a machine with three qualities: (1) a robot can sense its environment, (2) a robot has the capacity to process the information it senses, and (3) a robot is organized to act directly upon its environment.[27] I feel this definition—to which the literature refers as the "sense, think, act" paradigm—best reflects how robots differ from previous or constituent technologies such as a laptop.[28] For the purposes of this article, however, I did not use my own definition to screen out any technology. Rather, I looked for the court to use the word robot or a close synonym. However, I did exclude cases—such as *CNET Networks, Inc. v. Etlize, Inc.*—where the "robot" at issue referred exclusively to a software program running in the background of a server of website.[29] The robots that follow tend to be embodied, physically, in the real world.

Even with these various heuristics in place, the role of the robot in the majority of cases is best characterized as incidental. By incidental, I mean that the case would likely have come out exactly the same way were the technology at issue not a robot but some other object or concept. Maybe it's a copyright case where robots happen to figure into the plot that the plaintiff alleges was unlawfully copied.[30] Or perhaps it is a case of medical

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[26] This is an admittedly imperfect heuristic. I acknowledge the limitations of using headnotes and syllabi, written not by the courts themselves, but by lawyers after the fact.

[27] Calo, *supra* note 8, at 529-32.

[28] *Id.* at 529.

[29] *See* CNET Networks, Inc. v. Etlize, Inc., 547 F. Supp. 2d 1055, 1065 (N.D. Cal. 2008) (defining the term "crawler" in the context of a patent dispute).

[30] *E.g.*, FASA Corp. v. Playmates Toys, Inc., 869 F. Supp. 1334 (N.D. Ill 1994) (finding that "robot-like battle machines" are familiar themes not subject to copyright protection).

malpractice where the surgeon operated on the plaintiff with a surgical robot.[31] The movie plot could involve aliens or the surgery happen manually and present the court with the identical legal issue.

Many of these incidental cases are quite interesting. In *Robotic Vision Systems, Inc. v. Cybo Systems, Inc.*, for instance, a client of a robotics firm sued because, rather than send human technicians to resolve an installation problem, the robotics firm sent two robots named Al Bove and Al Treu.[32] The client found the robots annoying and unhelpful and sued for breach of contract. In *Reinhardt v. Fuller*, a criminal defendant fired four shotgun blasts at a police robot during his arrest.[33] Robotic props have repeatedly caused injuries on stage and film by behaving unexpectedly, including on the set of a movie *about machines that came alive and hurt people*.[34] These are colorful facts. Nevertheless, the issues tend to turn on standard principles of contract, criminal, and tort law. What distinguishes the cases that follow is that they turn in some way on the unique features of robots.

In short, I used a particular heuristic to sort cases that involve robots into two categories: cases where the existence of a robot was incidental and cases where the robot was arguably instrumental. From the latter I generated the six case studies that follow.[35] In this Part, I present these cases and offer commentary on the court's analysis.

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[31] *E.g.*, Balding v. Tarter, 3 N.E.3d 794 (Ill. 2014) (denying an appeal from a medical malpractice case involving robot-assisted prostate surgery).

[32] 17 F.Supp.2d 151 (E.D.N.Y. 1998).

[33] 2008 WL 5386802 (E.D. Cal. 2008).

[34] "[O]n the set of a motion picture entitled Maximum Overdrive," the plaintiff "sustained severe and permanent damage to his 'shooting eye' when a remote controlled powered lawnmower lost control." Nannuzzi v. King et al., 660 F. Supp. 1445, 1446 (S.D.N.Y. 1987) (remanding action to state court). *See also* Provenzano v. Pearlman, Apat, & Futterman LLP, 2008 WL 4724581 (E.D.N.Y. 2008) (unreported legal malpractice case where plaintiff failed to recover against manufacturer when robotic camera struck her in the head); Paul McCann, *TV robot injuries studio workers*, THE N.Y. TIMES, Jan. 8, 2000 ("During filming recently, a 170 lb robot came to life after it was switched off and careered out of control, injuring a stage technician. He needed stitches for an ankle wound caused by sharp spikes on the robot.").

[35] The closest set of methodology commitments to my approach are likely grounded theory, which recommends approaching a data set without a preconceived hypothesis, and thematic network analysis. For a discussion of grounded theory, see ANSELM STRAUSS & JULIET CORBIN, GROUND THEORY METHODOLOGY: AN OVERVIEW, IN HANDBOOK OF QUALITATIVE RESEARCH (1994). For a discussion of thematic network analysis, see JENNIFER ATTRIDE-STIRLING, THEMATIC NETWORKS: AN ANALYTIC TOOL FOR QUALITATIVE RESEARCH, QUALITATIVE RESEARCH 1:3, 385-405 (Dec. 2001). I am grateful to Meg Jones for these suggestions.

A. Appropriation by Robot

I have already mentioned what is perhaps the most visible case involving a robot, that of *White v. Samsung*.[36] In the early 1990s, the electronics giant Samsung ran an amusing series of print ads speculating about the future. One depicted a "female-shaped robot … wearing a long gown, blonde wig, and large jewelry" standing on what appeared to be the set of the game show *Wheel of Fortune*.[37] The caption read "Longest-running game show. 2012 A.D."[38] The host of *Wheel of Fortune*, Vanna White, sued Samsung in federal district court for violating her right of publicity and falsely implying an endorsement. The trial court rejected her claims on summary judgment and White appealed.

The Ninth Circuit reversed. The appellate court agreed with the district court that, for purposes of California's right to publicity statute, Samsung had not "knowingly use[d] another's name, voice, signature, photography, or likeness."[39] Relief under the statute is narrow: the term "likeness" is limited to a visual depiction of the plaintiff.[40] Because Samsung's ad "used a robot with mechanical features, and not, for example, a manikin molded to White's precise features," it did not fall within the meaning of California Civil Code section 3344.[41] "However," the Ninth Circuit found, "the common law right of publicity is not so confined."[42]

In finding for White under the common law right to publicity, which also involves the appropriation of a plaintiff's name, picture, or other likeness, the court offered an elaborate hypothetical:

> *Consider a hypothetical advertisement which depicts a mechanical robot with male features, an African-American complexion, and a bald head. … The ad depicts the robot dunking a basketball one-handed, stiff-armed, legs extended like open scissors, and tongue hanging out. Now envision that this ad is running on television during professional basketball games. Considered individually, the robot's physical appearance, its dress, and its stance tell us little. Taken together, they lead to the only conclusion any sports viewer who has registered a discernable pulse in the past five years would reach: the ad is about Michael Jordan.*[43]

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[36] 971 F.2d 1395 (9th Cir. 1992), *cert. denied*, 508 U.S. 951 (1993).
[37] *Id.* at 1399.
[38] *Id.* at 1396.
[39] *Id.* at 1397.
[40] *Id.*
[41] *Id.*
[42] *Id.*
[43] *Id.* at 1399.

Similarly, Samsung's depiction of a robot in a gown, jewelry, and blonde wig turning over letters on a game show set could only signify Vanna White. To limit liability on these facts would be, for the majority, to "permit the evisceration of the common law right of publicity."[44]

Judge Alarcon, dissenting, would not have drawn a distinction between the common law and statutory notions of "likeness."[45] For Judge Alcaron, nearly every issue boiled down to the impossibility of anyone confusing the robot for the host. It was "clear that a metal robot and not the plaintiff, Vanna White, is depicted in the commercial advertisement" and indeed "no reasonable juror could confuse a metal robot with Vanna White."[46] The "crude features of the robot are very dissimilar to Vanna White's attractive human face."[47] Put simply: "One is Vanna White. The other is a robot. No one could reasonably confuse the two."[48]

Samsung's robot generates a tension, evident in the sheer distance between the majority and dissent's respective starting points. For the majority, a robot in these circumstances could not but invoke an individual to anyone with "a discernable pulse."[49] For the dissent, the distinction between a robot and a person is "patently clear."[50] You see hints of the tension in the majority's conflicting interpretation of "likeness" for purposes of statutory and common law, as well as its analysis of likelihood of confusion under the Lanham Act. "One the one hand," noted the majority, "all of the aspects of the robot ad identify White; on the other, the figure is quite clearly a robot."[51]

The Ninth Circuit would confront the issue again just a few years later in *Wendt v. Host International, Inc.*[52] This action was brought by the two actors who played famed barflies Cliff and Norm on the television show *Cheers*.[53] Plaintiffs alleged that the defendant company built two "animatronic robotic figures" or "robots" of them for use in airport bars modeled on the set of *Cheers*, violating their individual rights of publicity

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[44] *Id.*

[45] *Id.* at 1402 (Alarcon, J., concurring in part, dissenting in part).

[46] *Id.* at 1404, 1405.

[47] *Id.* at 1406 (discussing plaintiff's claims under the Lanham Act).

[48] *Id.* Judge Alarcon—like Judge Kozinski in *Wendt*—drew a distinction between Vanna White's role as host and her identify as an individual. *Id.* at 1404. Moreover, he thought it was clear from the fact that Samsung was using a robot, rather than Vanna White herself, that she did not endorse their product. *Id.* at 1407.

[49] *Id.* at 1399.

[50] *Id.* at 1404.

[51] *Id.* at 1400.

[52] 125 F.3d 806 (9th Cir. 1997).

[53] *Id.* at 809.

by appropriating their likenesses for purposes of the same California state statute at issue in *White*.[54] The robots differed from the clearly metal robot in *White* in that they were embodied, human-looking, and had specific names (Hank and Bob) that differed from those of the plaintiffs.[55] The district court, observing both the robots and the plaintiffs "live" and in person, found them "totally different" and ordered summary judgment for the defendant.[56]

Again the Ninth Circuit reversed. It began by noting that *White* left open the prospect that a "manikin molded to [plaintiff's] precise features" could qualify as a likeness even under the California statute.[57] The appellate court then concluded from *its own* inspection of the robots that a reasonable jury could find them similar enough to violate California law.[58] The court also found likelihood of confusion, in part because people would come up to the plaintiffs and say things like, "Hey George, I just had a drink with you in Kansas City."[59] There was no dissent in *Wendt* but, as alluded to above, Judge Kazinski vehemently dissented from the Ninth Circuit's decision to deny rehearing en banc.[60]

White or *Wendt* are well-known cases of robot impersonation, appearing in textbooks on torts and intellectual property. Less remembered is the earlier case of *Elnicky Enterprises v. Spotlight, Inc*.[61] Rather than a robot copy of a person, *Elnicky* involved a robot copy of another robot. The key question in *Elnicky* was: did the defendant's action of replicating the plaintiff's robot, which he used at trade shows to entertain corporate guests, constitute a violation of the Lanham Act prohibitions on unfair competition?[62]

Throughout its analysis, the *Enlicky* court referred to Rodney and Walter Ego as "he."[63] As in *Wendt*, the judge observed Rodney, the original

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[54] Unlike in *White*, the defendant in *Wendt* received explicit permission from the television show to build the surrounding environment. Thus, plaintiffs proceeded entirely in their personal capacity. *See id.*

[55] *Id.*

[56] *Id.*

[57] *Id.* at 810.

[58] *Id.* ("[W]e conclude from our own inspection of the robots that material facts exist that might cause a reasonable jury to find them sufficiently 'like' the appellants.").

[59] *Id.* at 813.

[60] Wendt v. Host Int'l, Inc., 197 F.3d 1284 (9th Cir. 1999) (Kozinski, J., dissenting from denial of petition for rehearing). His basis was that actors should not retain intellectual property rights in the characters they play. *Id.*

[61] Elnicky Enterprises, Inc. v. Spotlight Presents, Inc., 1981 WL 48202 (S.D.N.Y. 1981).

[62] *Id.* at *1.

[63] *See, e.g., id.* at *1-2.

robot, as well as the usurper Walter Ego.[64] According to the court, "Rodney was casually attired and presented a rakish appearance," whereas "Walter Ego is clean shaven, and has a grin reminiscent of Mortimer Snerd."[65] Rodney was of higher quality and operated with greater skill.[66] And the court went out of its way to note that Rodney's design likely couldn't be patented.[67] Nevertheless, the court found the two robots to be so similar as to confuse potential consumers.

The case made headlines in 1981. The reason had less to do with the difficult competition law question and more with the relief U.S. District Judge Charles Brieant went on to order. The judge wanted Walter Ego dismantled above the torso.[68] This was a strange Lanham Act remedy to say the least, and prompted news stories with headlines like "Robot beheaded" and "Walter Ego loses his head" across North America.[69] The case has since faded with history.

The entire line of robot appropriation cases is interesting for the light it sheds on judicial and public assumptions around robots.[70] In previous work, I have noted that robots contain a unique social valence among artifacts.[71] In psychological studies, for instance, respondents struggle to characterize robots as animate or inanimate.[72] In *White* and *Wendt*, courts are struggling instead with whether a robot version of a person can be said to *represent* that person in the way the law cares about. And in *Enlicky*, the public is reacting to a remedy that feels odd or even wrong given the anthropomorphic qualities of the disputed object, but which would fail even to raise an eyebrow were the artifact a toaster. The purpose of this section was to introduce the general ambiguity that surrounds robots as surrogates;

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[64] *Id.*

[65] *Id.* at *1, *4. Mortimer Snerd was a puppet used by the legendary ventriloquist Edgar Bergen.

[66] *Id.* at *4.

[67] *Id.* at *10 ("In this Court's view, any patent issued for Rodney or any parts of his articulation would be void for obviousness.").

[68] *Id.* at *12 (finding that "the dismantling of Walter Ego's head and torso will be required").

[69] *See* Robot Beheaded, WILMINGTON MORNING START, Aug. 4, 1981. ("'Off with his head!' a judge has ordered in the case of a robot born of a stolen design."); *Walter Ego loses his head*, THE MONTREAL GAZETTE, Jul. 21, 1981. For a contemporary example of the media's fascination with beheaded robots, see Jack Nicas, *Mannequins Step In For Human Billboards, But Some Are Losing Their Heads*, WALL ST. J., Nov. 30, 2015.

[70] Cases in this line continue. In the recent *Brill v. Walt Disney Co*., for example, a stock car driver sued a motion picture studio for allegedly appropriating his likeness with a driverless car. 246 P.3d 1099, 1103 (2010).

[71] *See* Calo, *supra* note 8, at 545-49.

[72] Id, at 532 (citing Peter H. Kahn, Jr., et al., *The New Ontological Category Hypothesis in Human-Robot Interaction*, 2011 PROC. 6TH INT'L CON. ON HUMAN-ROBOT INTERACTION 159 (collecting studies)).

the next few cases explore the issue in greater detail.

B. Robotic Performance

A robot can appropriate the likeness of a performer under certain conditions. But can a robot itself "perform"? The question came up in the context of a tax on entertainment. In *Comptroller of the Treasury v. Family Entertainment Centers*, a Maryland special appeals court had to decide whether life-sized, animatronic puppets that dance and sing at Chuckie Cheese restaurants trigger a state tax on food "where there is furnished a performance."[73] In its analysis, the court looked to Webster's dictionary, which defines performance as a "formal exhibition of skill or talent as a play, musical program, etc.; a show."[74] For the court, it followed that a performance "has connotations of inherent human input that leaves room for spontaneous imperfections during the exhibition of skill or talent."[75]

The court found that, while they "are designed to give the impression that they are performing," the Chuckie Cheese robots fell outside the scope of the statute.[76] In the court's words:

> *[A] pre-programmed robot can perform a menial task but, because a pre-programmed robot has no 'skill' and therefore leaves no room for spontaneous human flaw in an exhibition, it cannot 'perform' a piece of music … Just as a wind-up toy does not perform for purposes of [the statute,] neither does a pre-programmed mechanical robot.*[77]

The original tax court also found it noteworthy that the "cyberamic figures" the restaurant chain purchased had yet to be invented when Maryland passed its performance tax statute.[78] Had they existed, the lower court reasoned, surely the legislature would have added them to the list of exceptions, which include "mechanical music, radio, or television, alone."[79] Both the tax and special appeals courts invoked a juke-box as the closest analogy to the robots in Chuckie Cheese.

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[73] 519 A.2d 1337, 1338 (Md. 1987). The case was eventually overruled on other grounds involving the question of whether Chuckie Cheese tokens counted as "tickets" for purposes of municipal tax law. *See* 318 North Market Street, Inc. at al. v. Comptroller of the Treasury, 554 A.2d 453 (Md. 1989).

[74] *Id.* at 1339.

[75] *Id.*

[76] *Id.*

[77] *Id.*

[78] Family Entertainment Centers of Essex, Inc. v. Comptroller of the Treasury, 1985 WL 6106, *1 (Md. Tax 1985).

[79] *Id.*

Is a robot an "embellished juke-box"? And would a legislature today include robots in a similar ordinance? Consider the example of *The Robotic Church*, a 2014 art installation by noted sculptor Chico MacMurtrie.[80] MacMurtrie filled a deconsecrated church in the Red Hook neighborhood of Brooklyn with forty or so kinetic sculptures.[81] The sculptures used a wide variety of mechanisms to generate noises and movement at random intervals. The effect is inhuman and surreal, and varies depending on where the audience stands, what robots happen to be working that day, and myriad other factors. It seems unlikely that any visitor could walk away doubting he or she had seen a performance, let alone that the installation was best analogized to a jukebox.

Following the court's reasoning in *Family Entertainment Centers*, MacMurtrie's installation is not a performance because the sculptures have no "skill" and can't exhibit spontaneous flaws.[82] Nor can we say that it is the artist MacMurtrie who is really performing; presumably someone also built the robots in Chuckie Cheese and programmed them to move about in a specific way as well. Consider, too, the ambiguity around the term "preprogrammed." At the time of *Family Entertainment Centers*, robots largely carried out repetitive tasks. By the late eighties, many factories had mechanized every task they could, resulting in an explosion in the number of so-called industrial robots.[83] These machines could only do what they were programmed to do.

Even at the time of *Family Entertainment Centers*, however, roboticists at the Stanford Research Institute (SRI) had developed the famous robot Shakey, capable of basic autonomous actions such as mapping a room and planning a path around an obstacle.[84] Robotics has since moved toward ever greater adaptability. Today's robots "learn" tasks just by watching human demonstrations or even through the robot's own trial and error.[85] The robotic warehouses of online retail giant Amazon "organize themselves," such that no human necessarily knows where an item is on the shelf.[86]

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[80] [cite]

[81] *Id.*

[82] Presumably the word "spontaneous" in this context excludes sudden glitches, for which real robots are famous. A Chuckie Cheese robot that, say, spontaneously combusted would not suddenly be engaged in a performance.

[83] [cite]

[84] For a nice account of Sharkey, see JOHN MARKOFF, MACHINES OF LOVING GRACE: THE QUEST FOR COMMON GROUND BETWEEN HUMANS AND ROBOTS (2015) 1-7. Robotic art also dates back to the 1960s. *See* Eduardo Kac, *Foundation and Development of Robotic Art*, ART J. 56:3, 60-67 (Autumn, 1997).

[85] Calo, *supra* note 8, at 538-39.

[86] The tagline of Kiva Systems, prior to its purchase by Amazon in 2012 for $775 million, was: "Where products organize themselves." Ryan Calo, *A Robot Really Committed a Crime: Now What?*, FORBES, Dec. 23, 2014,

Artists, including music artists, are aware of robots' new aptitude for spontaneity. They build robots that create art and play alongside robots in live concerts.[87] If ever there were a line between human and robot spontaneity or skill, it is rapidly disappearing.

C. Animate Objects

Closely related, perhaps, is the question of whether a robot represents something "animate" for purposes of tariff schedules. This question has come up repeatedly in American case law, as far back as the 1950s. For historic reasons, taxes on dolls have differed from those on other toys.[88] Tariff law understands dolls—which vary widely in terms of size, materials, and detailing—as distinct from other toys in that dolls represent "animate" life. Thus, the Tariff Act of 1930 drew a distinction between "Figures or images of animate objects, wholly or in chief value of metal" and toys "having a spring mechanism (except figures or images of animate objects)."[89]

In *Louis Marx & Co. and Gehrig Hoban & Co., Inc. v. United States*, a customs court had to decide whether a "mechanical walking robot" being imported represented an animate object.[90] The importers argued that it did, and therefore that the robot should be taxed at 35 "per centum ad valorem" instead of the 50 percent assessed by customs officials.[91] According to the trial transcription, the judge asked counsel for the plaintiff-importers whether the toy was "an imitation of an animate object."[92] Counsel replied: "Yes, a robot. It is as a synthetic man. It is something imitating men. That is the animate object that this particular toy represents. Also, the common meaning of robot supports our contention."[93]

The court disagreed. As in *Family Entertainment Centers*, the court turned immediately to the dictionary—in this case, two dictionaries.[94] In 1958, Webster's defined a "robot" as "Any automatic apparatus or device that performs functions ordinarily ascribed to human beings, or operates

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http://www.forbes.com/sites/ryancalo/2014/12/23/a-robot-really-committed-a-crime-now-what/#53862b9a1411.

[87] [cite]

[88] [cite]

[89] 19 U.S.C. § 1513 (1930).

[90] 40 Cust. Ct. 610, 610 (1958).

[91] *Id.*

[92] *Id.*

[93] *Id.* at 611. Another judge asked about the toy: "It is just a tiny robot?" To which counsel replied, "Yes." *Id.*

[94] *Id.*

with what appears to be almost human intelligence."[95] Funk & Wagnalls defined a robot as "An automaton that performs all hard work; hence, one who works mechanically and heartlessly."[96] To these, the court compared each dictionary's definition of the word "animate."[97] These were, respectively: "Endowed with life; alive" and "Possessing animal life, living."[98] For the court, there was "nothing in either of the quoted definitions from which to draw the conclusion that a robot is an animate object."[99] A robot is "not a living thing; it is not endowed with life. A robot is a mechanical device or apparatus, a mere automaton, that operates through scientific or mechanical media."[100] The court overruled plaintiffs' exception to the higher tariff.

As much as anything, the court's certainty about its decision in *Louis Marx & Co.* seems noteworthy. There was never any handwringing. And yet, at least one of the dictionaries the court consulted described robots as performing functions "ordinarily ascribed to human beings" and possessing "what appears to be almost human intelligence."[101] The other dictionary referred ambiguously to a robot as "one who works" in a particular way, almost as if to suggest that a robot is a specific type of person.[102]

The court's reasoning was curious in another way: it appeared to assume that the toy being imported—a mechanical walking robot—was not *itself* a robot, but only represented one. According to the court: "A robot is a mechanical device or apparatus, a mere automaton, that operates through scientific or mechanical media. It, therefore, follows that the toy under consideration, *which simulates a robot*, is not within the statutory language."[103] In other words, although a robot is a machine that simulates a person, a toy robot is only a simulation of the simulacrum. We are left to wonder how robotic a toy must be to itself qualify as a robot.

The same issue arose again in 1971 in *Lewis Galoob Co. v. United States*.[104] Custom officials had assessed a 35 percent duty on a battery-operated Japanese toy called the Swivel-O-Matic Astronaut rather than the 21 percent duty then applicable to toys figures of animate objects.[105]

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[95] *Id.* (citing *Webster's New International Dictionary*). The 2016 *Merriam-Webster Dictionary* defines robot differently. *See* infra.

[96] *Id.*

[97] *Id.*

[98] *Id.*

[99] *Id.*

[100] *Id.*

[101] *Id.* (citing *Webster's New International Dictionary*).

[102] *Id.* (citing *Funk & Wagnalls New Standard Dictionary*).

[103] *Id.* (emphasis added).

[104] 66 Cust. Ct. 484 (1971).

[105] *Id.* at 485.

According the customs court, the Japanese toy consisted of a "representation" of a "mechanical robot" that, when activated, "slides forward on rubber wheels at the bottom of the feet."[106] The toy's chest lit up and opened to reveal two guns that pop out and appear to fire. A chief difference between this toy and that at issue in *Louis Marx & Co*. is the presence of a human face (like an astronaut).[107] Nevertheless, the court had no trouble characterizing the robot as representing something inanimate: "the presence of a human face in an article which is otherwise incapable of representing any living being cannot make 'animate' what is, in totality, incapable of animation or life."[108] Again, the plaintiff's exception was overruled.

By the 1990s, tariff law had changed to mention robots.[109] Interestingly, given the case law, the Harmonized Tariff Schedule characterized robots as "non-human creatures" and lumped them in with toys representing animals.[110] The operative distinction became whether a given item for import constituted a "doll," which in turn required that the toy specifically represent a human being.[111] This, too, proved contentious, as the 2003 case of *Toy Biz, Inc. v. United States* illustrates.[112]

In *Toy Biz, Inc.*, the U.S. Court of International Trade had to determine whether figurines of Marvel Comics superheroes and villains were dolls and hence subject to a tariff of 12 percent, rather than the 6.8 percent applicable otherwise.[113] This in turn required the court to decide if the fictional characters, some of which had robotic features, were themselves human. Sometimes the choice was easy: the character Robot Wolverine is obviously a robot and hence a non-human creature.[114] In other instances the call was harder. Is Spider Man not a human being? What about Kingpin, who is just a very bad person?[115]

To decide, the court made the familiar move of consulting a dictionary. The Oxford English Dictionary the court consulted defined a robot as "a machine (sometimes resembling a human being in appearance) designed to function in place of a living agent."[116] More relevant to the court, however,

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[106] *Id.*
[107] *Id.*
[108] *Id.* at 486.
[109] *See* Harmonized Tariff Schedule of the United States, 9502.10.00 et seq. (1994).
[110] *Id.* at 9503.49.00, HTSUS (1994).
[111] *Id.* at 9503.70.90, HTSUS (1994).
[112] 248 F. Supp. 2d 1234 (U.S. Ct. Int'l Trade 2003).
[113] *Id.* at 1240.
[114] *Id.* at 1241 n.10 (discussing imports that the parties stipulated to be non-human).
[115] *Id.* at 1252 ("Nothing in the storyline indicates that Kingpin possesses superhuman powers.").
[116] *Id.* at 1251 (citing 9 OED 1036-37 (2d ed. 1989)). Today the OED has a long

was the OED's definition of a "mutant," which is how Marvel Comics characterized most of the figurines.[117] The OED emphasized that a mutant *begins* as a human but winds up as something else by virtue of a mutant gene.[118] Thus, by definition, mutants are no longer human beings and hence representations of them are not dolls, at least according to the court.

Toy Biz, Inc. helps illustrate how the evolution of human imagination—reflected, for instance, in the evolving definition of the term robot—winds up posing interesting challenges around legal categorization. Again we see evidence of confusion and equivocation. For instance: in a world of prosthetic hearts, ears, arms, and legs, what do we make of the court's contention that "robotic features, such as artificial eyes or limbs," militate against a finding of humanity?[119] And why would one such robotic feature convert a person into a robot when a human face does not convert a robot into an astronaut?[120] I discuss these issues in greater detail in Part III.

D. Robot Possession

The case studies I've presented thus far interrogate the degree to which robots resemble people. The next two case studies involve a different question, namely, whether robots can be thought of as extending people into physical space in ways the law cares about. The contexts—maritime law of salvage in this section and state criminal law of burglary in the next—are quite disparate. But there are nevertheless some interesting similarities.

Salvage rights to a famous shipwreck were at issue in the next robot case, *Columbus-America Discovery Group, Inc. v. The Unidentified, Wrecked, and Abandoned Vessel, S.S. Central America*.[121] The *S.S. Central America* was a steamship that sank in the Atlantic Ocean in 1857 carrying gold from the California Gold Rush.[122] Many looked for the *Central America* following its accident; no one could find it. One hundred and thirty years later, a high tech operation discovered the wreckage and claimed first

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definition of robot that encompasses everything from a "machine capable of automatically carrying out a complex series of movements, esp. one which is programmable" to a "central European system of serfdom, by which a tenant's rent was paid in forced labour or service" to a "traffic light." [cite]

[117] 248 F. Supp. 2d, at 1251 (citing 10 OED at 145-46).

[118] *Id.*

[119] *Id.* at 1251.

[120] *See supra*, note 105 and accompanying text.

[121] 1989 A.M.C. 1955 (1989).

[122] Columbus-America Discovery Group, Inc. v. The Unidentified, Wrecked, and Abandoned Vessel, S.S. Central America, 742 F.Supp. 1327, 1328-29 (E.D. Va. 1990) (describing the facts around the shipwreck and salvage operation), rev' on other grounds by Columbus-America Discovery Group, Inc. v. Atlantic Mut. Ins., 974 F.2d 450 (4th Cir. 1997).

salvage rights at maritime law.[123] Columbus-America Discovery Group made use of some very new technology for the late 1980s, including an unmanned (i.e., robotic) submersible equipped with cameras and actuators capable of grasping objects at the direction of its operators.[124]

The trial court in *Columbus-America* had to decide whether, for purposes of salvage law, Columbus-American Discovery Group "achieved exclusive custody, control, and possession of the wreck."[125] First salver rights at maritime law entitle the operation to recover some substantial portion of the treasure aboard the vessel as well as exclude other potential salvers.[126] And indeed, several other teams were in the area searching for the *Central America*, leading the Columbus-America Discovery Group to ask the court to enjoin anyone else from entering the immediate salvage zone.[127]

The usual way for custody, possession, and control to be achieved at this time was by human divers approaching the vessel and either recovering property over time or, if safe, lifting the wreck out of the water.[128] The salvage team in *Columbus-America*, however, was not able (or willing) to send anyone that far down—nearly one and one half miles below the surface. It sent down its robots instead.[129]

The court decided that, in light of the conditions, sending the robots counted for purposes of effective control and possession. They were, after all, able to generate live images of the wreck and had the further "capability to manipulate the environment" at the direction of people.[130] The court fashioned a new test for effective possession through "telepossession," consisting of four elements: (1) locating the wreckage, (2) real-time imaging, (3) placement of a robot near the wreckage with the ability to manipulate objects therein, and (4) intent to exercise control.[131] As maritime law scholar Barlow Burke, puts it: "This is as close as the court can come to creating a new legal basis for establishing possession without actually doing so."[132] On the basis of the new test, which has been cited by other courts

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[123] *Id.*

[124] *Id.* at 1329.

[125] *Id.* at 1330.

[126] Columbus-America Discovery Group, Inc., 1989 A.M.C. at 1957-58.

[127] *Id.*

[128] *See* Barlow Burke, Jr., *A Reprise of the Case of Eads v. Brazelton*, 44 ARK. L. REV. 425, 456-58 (1991).

[129] Columbus-America Discovery Group, Inc., 742 F. Supp. at 1331 (noting that "salvage operations will ultimately be effected by the use of a remotely operated vehicle capable of handling the remains of the vessel and retrieving its contents").

[130] Columbus-America Discovery Group, Inc., 1989 A.M.C. at 1958.

[131] *Id.* at 1957-58.

[132] *See* Burke, *supra* note 128, at 456.

since, the court granted salvage rights to Columbus-America Group and enjoined its competitors.[133]

The 1990s saw a renaissance of deep sea treasure hunting, in large part due to advances in robotics.[134] Today the use of sea and undersea robotics is even more extensive. Both the public and private sector are making increasing use not only of teleoperated robots, i.e., machines under the constant direction of a remote pilot, but autonomous systems that explore the sea on their own.[135] Navy pilotless submarines monitor undersea activity.[136] And private or academic research vessels spend months on the open waves mapping out territory. The company Liquid Robotics lists over 625,000 autonomous miles at sea with its Wave Glider robots.[137]

It is interesting to note that *Columbus-America* and its progeny leave open the question of whether the *autonomous* discovery of a shipwreck could ever support a first salvage claim. There is reason to believe it might not. First, autonomous exploration does not technically meet the *Columbus-America* elements, which emphasize the role of a human operator above water and require intent to exercise control.[138] A court might not credit an autonomous submarine with the "intent" to record or manipulate a wreck, even were it physically able to do so. Second, the court's new standard grew from the recognition that high-seas salvage operations were dangerous, even if the crew did not go underwater.[139] This leaves open the prospect that an all-robot expeditions would not meet the spirit of so called telepossession because the human crew would be in safer waters or even on shore.[140]

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[133] R.M.S. Titanic, Inc. v. Wrecked & Abandoned Vessel, involving what is perhaps the most famous shipwreck in modern history, cites the Columbus-America test. 742 F. Supp. 2d 784, 794 (E.D. Virginia 2010). For another example of a case adopting the doctrine of telepossession, see Ocean Mar, Inc. v. The Cargo of SS Islander, 1998 WL 886109 (D. Alaska Aug. 28, 1998).

[134] [cite]

[135] R.M.S. Titanic, Inc., for instance, involved a mixture of teleoperated and autonomous submarines. 742 F. Supp. 2d at 799, n.20.

[136] *See* Craig H. Allen, *The Seabots are ~~Coming~~ Here: Should they be Treated as 'Vessels'?*, 65 J. NAVIGATION 749 (2012).

[137] *See* http://www.liquidr.com/ (last visited Feb. 17, 2016).

[138] Specifically, the fourth factor requires "present intent to control … the location of the object." Columbus-America Discovery Group, Inc., 1989 A.M.C. at 1958.

[139] *Id.* (finding that "Columbus-America has maintained a reasonable presence at the cite," given the "special circumstances which characterize deep ocean salvage, including rough seas, sailing distances to safe port, remoteness from repair facilities and assistance…").

[140] Obviously the stakes are entirely different, but this question mirrors in a sense contemporary arguments around the propriety of using drones or other robots to kill at distance without imperiling American soldiers. For a discussion, see Singer, *supra* note 18, at 309-14 (discussing perceptions of the United States' use of remote warfare).

E. The Robot Burglar

In 1887, an English court convicted Henry Hands of common law larceny for his appropriation of several cigarettes belonging to an Edward Shenton.[141] Despite somewhat unusual facts for the time, neither the lower court nor the court on appeal had any trouble characterizing Hands' actions as theft. What Hand and his accomplices did was use a brass and lead disc instead of a penny to retrieve cigarettes from Shenton's new "automatic box."[142] According to the court, Hands' substitution of a disc without value for a penny defrauded Shenton's machine—"the means … were fraudulent"—and thereby deprived Shelton of his cigarettes without his consent.[143]

Reg. v. Hand and Others involved theft from a machine. The case I want to examine here is the slightly more fanciful prospect of theft *with* a machine. Robots make another appearance in *People v. Davis*, a 1998 burglary case before the California Supreme Court.[144] The state accused Michael Wayne Davis of passing a bad check to a window teller through a chute. The teller grew suspicious and phoned the police, who picked up Davis while he was still waiting for the bank to cash the fraudulent check.

As in *Hand*, the trial and appellate courts in *Davis* had no problem finding larceny on these facts.[145] But one of the charges was burglary, i.e., entering a building or structure with the intent to steal. Relying on an earlier appellate decision in *People v. Ravenscroft*, the lower court found that Davis' actions were, in fact, a burglary as well.[146] *Ravenscroft* involved the burglary of an ATM through the use of a stolen card.[147] Other California courts had similarly held that any wrongful entry into a structure, however slight or partial, could support a burglary charge.[148] The dissent in *Davis*, like the lower court, would have found burglary in the act of approaching the security window and passing through it "an instrumentality to trick the teller into handing him money back."[149]

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[141] Reg. v. Hand and Others, LVI. Cr. Cas. Res. 370 (May 14, 1857). At English common law, larceny had similar elements to statutory theft today; the defendant must intentionally deprive another of goods of value without permission. *See* Minturn T. Wright III, Note, *Statutory Burglary—The Magic of Four Walls and Roof*, 100 U. PENN. L. REV. 411 (1951). Thank you to James Grimmelmann for bringing *Reg. v. Hand and Others* to my attention.

[142] Reg., Cr. Cas. Res. at 370.

[143] *Id.* at 371.

[144] 958 P.2d 1083 (Cal. 1998).

[145] *Id.* at 1084.

[146] *Id.* at 1087.

[147] *See* People v. Ravenscroft, 198 Cal. App. 3d 639 (1988).

[148] 958 P.2d at 1086-87 (citing cases).

[149] *Id.* at 1091(Baxter, J., dissenting).

The majority was of another view; it abrogated *Ravenscroft* and rejected the burglary charge.[150] The court first conceded that a defendant could commit burglary without himself entering the premises—for instance, through the use of a robot. "Instruments other than traditional burglary tools certainly can be used to commit the offense of burglary."[151] For example, "a robot could be used to enter the building."[152] But "it does not necessarily follow from these conclusions that insertion of a stolen card into an ATM constitutes a burglary."[153] A robot represents a new means by which to accomplish the traditional ends of entry for the purposes of theft. The introduction of a card or check into a structure does not become entry merely because the defendant has a bad intent.

There is a certain intuitive appeal to the majority's reasoning. Passing a bad check through a chute does not feel analogous to entering a facility with a robot without the permission of the owner. Yet the line between a check and a robot may not be as sharp as the majority in *Davis* assumes. The line is not, for instance, that a robot enters the building and a check doesn't. Both enter the building, as the dissent pointed out.[154] And the owner of the building probably would no more consent to bad checks entering his or her bank than bad robots.

Nor is the line that a robot is always an invasion. The court envisions a robot entering a building that the robot's operator is forbidden to enter—a bank after hours—and extracting property.[155] But imagine instead that an individual visited a bank during business hours with a telepresence robot like those commercially available today.[156] Presumably no one would accuse someone with an immune deficiency of burglary by seeing about a loan by robot instead of in person.

Nor is the line that a human intermediary has to assist with the check by cashing it but not with the robot. Again, if a were person to "enter" a bank during business hours by telepresence and trick or coerce the clerk into

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[150] *Id.* at 1090.

[151] *Id.* at 1087.

[152] *Id.*

[153] *Id.*

[154] *Id.* at 1092, 1099. The dissent proposed that a burglary occurs whenever there is a burglar present at the scene. *Id.* at 1093 ("Simply put: no burglar at the crime scene, no burglary."). The majority invoked robots once again in criticizing this standard: "Under the dissent's proposed rule, a person who used a remote controlled robot, operated from across the street or across town, to enter the building for purposes of committing larceny or any felony would not commit burglary." *Id.* at 1090, n.7.

[155] *Id.* at 1087, 1090, n.7.

[156] A telepresence robot allows a person to control and robot remotely and navigate a space via computer. Often there is a video of the operator displayed on the "face" of the robot. The operator can also see or hear the environment and move around in space. *See, e.g.*, https://suitabletech.com/beam/.

handing over money—for instance, by pretending to be another customer or hinting at the presence of a bomb—presumably the *Davis* court would uphold a burglary charge despite the cooperation of the staff.

An even more interesting question arises if the robot is already inside the premises. Personal and service robots represent a significant and growing segment of the exploding robotics market.[157] These new robots are smarter and more versatile in part because they are connected to the Internet—a model James Kuffner calls "cloud robotics" in reference to the idea that the robot's intelligence is somewhere other than its body.[158]

A few years ago, security researchers at the University of Washington showed how easy it is to take over an Internet-enabled robot remotely.[159] The researchers could not only record audio and video, but could also move the robot around the household.[160] Imagine a thief were to take control of a robot already in the home and use it to drop an expensive item—car keys or jewelry—out of the mailbox. This activity would violate federal laws against hacking.[161] But is it a burglary? The robot had permission to enter the facility; the owner placed it there. But the thief did not have permission to enter the robot.[162]

F. The Unreliable Robot

This Part's final case study involves what we usually think of as the core interaction between robotics and law: legal liability for robot mishaps. This work can tend toward the fanciful and will often take the form of speculation. As David Vladeck, Patrick Hubbard, and others argue, however, some combination of tort law and safety regulations seems well-

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[157] The International Federation of Robotics keeps statistics on world trends with respect to robotics, which it breaks down according to category. Historically industrial robotics has comprised the bulk of the sector. In recent years, however, personal and service robots have gained a greater share. [cite] *See also*, Calo, *supra* note 8, at 526-28 (citing additional statistics).

[158] *See* Erico Guizzo, *Cloud Robotics: Connected to the Cloud, Robots Get Smarter*, IEEE SPECTRUM (Jan. 24, 2011).

[159] Tamara Denning, et al., *A spotlight on security and privacy risks with future household robots: Attacks and lessons, in: Proceedings of the 11th International Conference on Ubiquitous*, COMPUTING, Sept. 30–Oct. 3, 2009.

[160] *Id.*

[161] *E.g.*, Computer Fraud and Abuse Act of 1986, 18 U.S.C. § 1030 (1986) (prohibiting, inter alia, unauthorized access to a protected computer).

[162] Holographic projects raise an interesting question as well. In July of 2015, a music performer appeared by hologram at a concern in Hammond, Indiana from a studio in Los Angeles. As he was wanted on an arrest warrant in Indiana, the local police shut down the venue, telling concert goers that his virtual presence posed a safety risk. *See* Daniel Rivero, *This rapper's hologram is changing the way we think about protest*, FUSION, Sep. 15, 2015.

positioned to address physical harm by robots, at least in the near-term.[163]

I mostly agree with the Vladeck and Hubbard view with two exceptions. First, I believe the new collaborative ecosystem in robotics will shortly confront courts and lawmakers with a novel issue.[164] Someone will have to decide whether manufacturers of robots that are increasingly designed to run third-party code (colloquially, "apps") will be liable when that code leads to physical harm.[165] Federal law immunizes Internet and mobile platforms for what users say and do on those platforms on the theory that it is the user, not the platform, who "publishes" the relevant content.[166] But courts and Congress might decide to strike a different balance when bones and not bits are on the line.[167] Second, I believe robots will present courts with yet another opportunity to rethink proximate causation. The prospect that robots will behave in ways that are not foreseeable to the designer or user is probably closer than many legal scholars admit.[168] Part III explores this issue in greater detail.

For now, the role of the robot in cases involving physical harm is largely incidental. Every year a robot in a U.S. factory kills one or two people, according to statistics kept by OSHA.[169] Some of these deaths result in lawsuits.[170] There are also medical malpractice or product liability lawsuits that involve robotic surgery.[171] While some of the injuries people sustain would not occur with, for instance, comparable laparoscopic surgery, these cases do not seem to require a reexamination of tort doctrine.[172] We might expect more such cases as drones and other robotic products saturate the market. But as the Introduction makes clear, these and other incidental robot cases are outside the scope of this particular

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[163] *See* David C. Vladeck, *Machines Without Principles: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 118 (2014); F. Patrick Hubbard, *'Sophisticated Robots': Balancing Liability, Regulation, and Innovation*, 66 FLA. L. REV. 1803 (2014).

[164] Calo, *supra*, note 8, at 532-37 (discussing embodiment).

[165] *Id.*

[166] *See* Communications Decency Act of 1996, 47 U.S.C. § 230(c)(1) (2006) ("No provider of an interactive computer service shall be treated as the publisher or speaker of any information provided by another information content provider.").

[167] Calo, *supra*, note 8, at 532-37. *See also* Ryan Calo, *Open Robotics*, 70 MD. L. REV. 571 (2011).

[168] Calo, *supra*, note 8, at 538-45 (discussing emergence).

[169] John Markoff and Claire Cain Miller, *As Robotics Advances, Worries of Killer Robotics Rise*, N.Y. TIMES, Jun. 16, 2014.

[170] *E.g.*, Payne v. ABB Flexible Automation, Inc., 116 F.3d 480 (8th Cir. 1997).

[171] *E.g.*, Reece v. Intuitive Surgical, Inc., 63 F. Supp. 1337 (N.D. Ala. 2014).

[172] One possible exception is a case wherein an individual sued a hospital because it chose not to use a robot for surgery and to rely instead on a human-only surgery. Mracek v. Bryn Mawr Hosp., 2010 Lexis 2015 (3rd Cir. Jan. 28, 2010).

project.[173]

Here I want to concentrate on a narrow category of harms that involve humans relying on robotic systems to their or another's detriment. A relatively straightforward example is the 1949 case of *Brose v. United States*.[174] In *Brose*, a federal district court had to decide whether the government could be held responsible for a plane crash between an army fighter and small private plane. "It was clearly established," according to the court, "that the army plane at the time of the collision was under robot control."[175] The court's rejection of the government's position in *Brouse*—that the collision could not have been avoided through reasonable diligence—was emphatic. The court characterized the pilot's obligation "to keep a proper and constant lookout" as "unavoidable" and found the plaintiff's right to recovery on the facts to be "without question."[176]

Of course, robotic control today looks nothing like it did at time of the accident; in 1947, autopilot consisted of mechanical tension rods that merely kept the plane flying on the same path.[177] By 1994, navy fighter jets were landing on aircraft carriers without human input.[178] Nevertheless, as David Vladeck argues, "In cases involving other autonomous machines, liability has been difficult to establish where alternative theories of liability are present" that implicate a person's conduct.[179] Vladeck's main example is *Ferguson v. Bombardier Services Corp*.[180] *Bombardier Services Corp.* is a relatively recent case in which the court rejected liability for the manufacturer of an autopilot system. The system was engaged at the time of the crash and might have explained the crash.[181] But the court decided against the airline instead on the theory that the plane had been improperly loaded.[182]

The tendency of courts to locate liability for robots in people is subject to several caveats. First, as the Third Circuit observed in the context of a robotic practice pitcher that threw wild, "robots cannot be sued."[183] Thus,

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[173] [cite]

[174] 83 F. Supp. 373 (N.D. Ohio 1949).

[175] *Id.* at 374.

[176] *Id.* at 374-75.

[177] [cite]

[178] Philip E. Ross, W*hen Will We Have Unmanned Commercial Airliners?*, IEEE SPECTRUM (Nov. 29, 2011) (interview with roboticist and former navy pilot Missy Cummings), http://spectrum.ieee.org/aerospace/aviation/when-will-we-have-unmanned-commercial-airliners.

[179] David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 140 (2014).

[180] *Id.* at 140, n.78 (citing 244 F. App'x 944 (11th Cir. 2007)).

[181] *Id.*

[182] *Id.*

[183] United States v. Althone Industries, Inc., 746 F.2d 977, 977 (3rd Cir. 1984).

the question is not whether the robot will be liable, but only *which* person will be liable. Will it be the manufacture of the autopilot system or surgical robot, or the pilot and the surgeon?

Second, we do not necessarily see the same tendency in the absence of physical harm. Take the example of *Royal Insurance Company of America v. Crowne Investments*.[184] In *Royal Insurance*, the Supreme Court of Alabama had to decide whether to uphold a default judgment in favor of Crowne Investments. Crowne had served process to Royal but, according to Royal staff, the relevant email was lost due to a glitch in Royal's "robotic mail system."[185] The court could have followed the reasoning of *Brouse* and subsequent cases that people have a responsibility to monitor automated systems and risk being held accountable if they do not. Instead, the court declined to find that the default judgment. For the court, the glitch was not "a result of the defendant's own culpable conduct,"[186] and Royal was "in no way culpable" for its robotic mail system.[187]

II. ROBOTS AS LEGAL SUBJECTS

The first Part of this article offers a series of case studies as a corrective to the intuition that all interesting robot cases wait in the future. It hopes to illustrate that, while often the role of the robot is incidental to the underlying legal problem of a case, robots throughout the decades occasionally present courts with quite interesting or challenging issues. The way courts puzzle through them may shed some light on how the law may react to the rapid mainstreaming of robots we see today.

This second Part discusses another sort of case—a case in which no robot is at issue, except in the imagination of the judge. Reading through hundreds of cases, one is struck by the frequency and manner in which courts invoke robots to make observations about people or law. Humans are, or are not, like robots, a critical distinction that informs the legal issue before the court. What emerges is a fairly clear and consistent picture of a robot in the judicial mind: robots may appear to be agents or entities but in actuality are only tools. Robots are defined precisely by reference to their

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[184] 903 So.2d 802 (Ala. 2004).

[185] *Id.* at 806.

[186] *Id.* at 808 (Ala. 2003) (citing Kirtland v. Fort Morgan Auth. Sewer Serv. Inc., 524 So.2d 600, 605 (Ala. 1988)).

[187] *Id.* at 812. The court acknowledged that Royal was "at worse negligent." *Id.* In rare instances, courts may also hold parties accountable when a software problem results in injury to property or even economic loss. *E.g.*, Pompeii Estates, Inc. v. Consol. Edison Co. of N.Y., Inc., 397 N.Y.S.2d 577 (N.Y. Civ. 1977) (service termination following a computer glitch). But pure information-based harms are generally not compensated. *See* Ryan Calo, *Open Robotics*, 70 MD. L. REV. 598-61 2010 (furnishing examples).

complete lack of discretion or capacity for spontaneity or judgment.

It is fair to ask what, if any, lessons we can draw from the way judges talk about a given technology, especially when that technology is not before the court. Several strains of research suggest the importance of mental models to legal outcomes. As an initial matter, rhetorical allusions appear capable of shaping policy recommendations. In 2011, Paul Thibodeau and Lera Boroditzsky at Stanford University conducted an experiment (n = 1,482) in which they presented subjects with a description of an imaginary city experiencing a surge in criminal activity.[188] To one set of subjects, the researchers described crime in general as a "virus infecting the city" and "plaguing" neighborhoods.[189] To the other, they described it a "wild beast preying on the city" and "lurking in neighborhoods."[190] When asked for policy recommendations, subjects in the first condition recommended more enforcement 56% of the time and social reforms 44%.[191] Subjects in the second condition recommended enforcement and reform 75% and 25%, respectively.[192]

Indeed, judges rely on metaphor and analogy when reasoning through the protection law should afford to new technologies. In the context of cryptography, for instance, Michael Froomkin explores the four metaphors that seem to have the most appeal to the courts: encryption is like a "car" that carries information, a kind of "language," a "safe" that hides secrets, or a "house" in which conversation takes place.[193] According to Froomkin, a judge's selection of metaphor in turn reveals the level of First and Fourth Amendment protection the judge is willing to apply. If encryption is merely a car in which messages travel, it gets lesser constitutional protection.[194] But if encryption is itself a language, it may be protected quite fully. Froomkin's conclusion is that "ideas are weapons."[195]

Judges appear from remarks and arguments to possess a highly homogenous mental model of what a robot is. It turns out not to be a particularly accurate one: The puzzles and potential mistakes that arise in

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[188] Paul H. Thibodeau and Lera Boroditsky, *Metaphors We Think With: The Role of Metaphor in Reasoning*, PLOS ONE 6(2): e16782 (2011).

[189] *Id.* at 3-4.

[190] *Id.* at 3.

[191] *Id.*

[192] *Id.* at 6.

[193] A. Michael Froomkin, *The Metaphor is the Key: Cryptography, the Clipper Chip, and the Constitution*, U. PA. L. REV. 709, 861-62 (1995).

[194] *Id.* at 879.

[195] *Id.* at 843 (title of Part IV). *See also* Orin S. Kerr, *The Problem of Perspective in Internet Law*, 91 GEO. L.J. 357 (2003) (arguing that courts come to different conclusions about the scope of a warrant or other Fourth Amendment issues depending on whether they take an "insider" or "outsider" view of the technology).

Part I arguably make more sense as we build out the typical judge's mental model of robots. And the way judges talk about robots, catalogued here for the first time in the literature, provides fodder for future investigations of robotics law and policy, which are the subject of Part III. But ultimately I acknowledge that a judge may invoke robots in one way but decide robot related cases in another.

A. The Robot Judge

Robots appear repeatedly in discussions of judicial bias. Confronted with a variety of allegations, many opinions remind us that judges are flesh and blood people. Litigants may *expect* judges to be robotic, but they are not. And nor should they be. We would not want to dispense with human judgment. As one court put it: "We have not, and hopefully never will reach the stage in Alabama at which a stone-cold computer is draped in a black robe, set up behind the bench, and plugged in to begin service as Circuit Judge."[196]

This claim arises in at least two contexts. The first is the reaction of trial judges to the presentation of evidence or other behavior. Perhaps a judge laughs with a funny witness or betrays emotion at the plight of the victim, or displays impatience over delay or interruption.[197] Opposing counsel seizes on this moment in an effort to show the judge is prejudiced against their client. Courts almost universally reject these challenges, often citing to the holding of *Allen v. State* that "the trial judge is a human being, not an automaton or a robot."[198]

Even in the absence of a reaction from the bench, litigants may question whether the very identity of a jurist suggests partiality. A fascinating and historically important case is that of *Commonwealth of Pennsylvania et al. v. Local Union 542 et al*. from 1974.[199] *Local Union 542* involved allegations of racial discrimination by twelve black workers against a predominantly white labor union.[200] The union sought to disqualify the federal district court who was assigned to the case on the basis that he was himself black and had recently addressed a group of black historians, at

[196] Allen v. State, 290 Ala. 339, 342 (1973).

[197] *E.g.*, Keppel v. BaRoss Builders, Inc. 7 Conn. App. 435, 509 (1986) ("Above all, it showed that a judge is a human being, not the type of unfeeling robot some would expect the judge to be."); Fletcher v. State, 291 Ala. 67, 69 (1973) ("[T]he trial judge is not required to be a robot without emotional reaction to happenings in his court. Impatience with excessive delay by counsel is a natural and understandable reaction.").

[198] 290 Ala. at 342.

[199] Commonw. of Penn. and Raymond Williams et al. v. Local Union 542, Int. Union of Op. Eng., et al., 388 F. Supp. 155 (1974).

[200] *Id.* at 163, n.7.

which time the judge allegedly displayed "an intimate tie with and emotional attachment to the advancement of black civil rights."[201]

In rejecting the challenge to his impartiality, Judge Higginbotham noted that white judges were free to pursue their own interests and concerns outside the bench; no one expected white judges to renounce their heritage or history to maintain impartiality.[202] The union's recusal motion implied that black judges, in contrast, must be "robots who are totally isolated from their racial heritage and unconcerned about it," or at least refrain from discussing that heritage.[203] "Should they be robots?" Judge Higgonbotham asked of black judges; no more so than any other jurist.[204]

A second context in which we see the specter of the robot judge is in discussions of judicial discretion. A judge need not, for instance, "robotically recite" every statutory consideration in the course of meting out a sentence under the federal sentencing guidelines,[205] or "recite robotic findings" to establish that conditions have changed in a given country for purposes of rejecting asylum.[206] American law follows from a code, but not in the sense of software code that a judge executes like a computer.[207] We assume a judge has considered relevant factors unless we have evidence to the contrary.

Also interesting for our purposes is the observation that appellate courts do not, by reversing and remanding a decision, turn the trial court into *their* robot. Obviously a decision by a higher court "severely limits the kinds of considerations open" to a lower court on remand.[208] At the same time: "An appellate mandate does not turn a district judge into a robot, mechanically carrying out orders that become inappropriate in light of subsequent discoveries or changes in the law."[209] A lower court judge interested in

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[201] *Id.* at 157.

[202] *Id.* at 165.

[203] *Id.* at 178.

[204] *Id.* at 180. In Local Union 542, the court believed that the petitioners expected black judges to be more robotic than white ones. Meanwhile, in *White v. Samsung*, the Ninth Circuit chose a hypothetical about a famous black athlete to illustrate just how close robots can come to the people they depict. For a further discussion, see *infra* Part III.A.

[205] United States v. Ruiz-Salazar, 785 F.3d 1270, 1272-73 (8th Cir. 2015). Other cases dispense the requirement to make "robotic incantations that each factor has been considered." *See, e.g.*, United States v. Blackmon, 662 F.3d 981, 988 (8th Cir. 2011) (citing United States v. Lamoreaux, 422 F.3d 750, 756 (8th Cir. 2005)).

[206] Hoxhallari v. Gonzalez, 468 F.3d 179, 187 (2d Cir. 2006).

[207] Cf. John Greenman, *On Communication*, 106 MICH. L. REV. 1337, 1375 (2008) (advancing a free-will theory of the First Amendment that disputes computer code is speech).

[208] Anand v. Nat'l Republic Bank of Chicago, 239 B.R. 511, 520 (N.D. Ill 1999).

[209] *Id.* (quoting Barrow v. Falck, 11 F.3d 729, 731 (7th Cir. 1993)). *See also* Jianli Chen v. Holder, 703 F.3d 17 (1st Cir. 2012) ("This multifaceted role is not meant to be

some wiggle room might say that the mere fact she was overturned does not mean she has lost all humanity or judgment.

The intuition may go deeper still, beyond the individual judge. There is a general sense among many litigants and some courts that an overly robotic judicial *system* is not a fair one. In challenging health regulations, for instance, appellants in *Kirk v. Secretary of Health and Human Services* argued that the new guidelines "robotize the adjudicative process, in violation of due process guarantees."[210] Although the court in *Kirk*, ultimately rejected appellants' claim, a similar argument has gotten traction in other contexts such as disability rights.[211] Though we are famously a government of laws, and not of men,[212] those laws are to be interpreted and applied by real men and women.

B. The Robot Juror or Witness

The judge is not a robot and neither is the quintessential finder of fact, the juror. It is not necessarily evidence of bias for a juror to laugh or cry during trial and our Constitution requires courts to scrutinize the bases upon which litigants strike jurors from service.[213] Courts also assume jurors who do serve are people with lived experience, not programmable machines.[214] Thus the court invoked robots in *Burch v. Reading Co.*, a case in which a widow with two children broke her ankle on the job.[215] The judge's instructions were adequate because jurors "are not robots who come to the court house with minds tabula rasa and who respond mechanically to every impression they receive in the courtroom."[216]

People are not robots. When they act like robots in court, this is

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robotic. The [Board of Immigration Appeals] is not bound to parrot the precise language used by the [immigration judge] but, rather, may use its own vocabulary.")

[210] Kirk v. Sec'y of Health & Human Serv., 667 F.2d 524, 531 (6th Cir. 1981).

[211] *E.g.*, Stewart v. Harris, 508 F. Supp. 345 (D.N.J. 1981). *See also* Jianli Chen v. Holder, 703 F.3d 17 (1st Cir. 2012) (noting that the role of the immigration appeals board "is not meant to be robotic" and that the board has the "prerogative—indeed the duty—of examining the basis for, and then synthesizing and analyzing, the [immigration judge's] findings.")

[212] John Adams, *Letters of Novanglus*, BOSTON GAZETTE (1774).

[213] *See, e.g.*, Batson v. Kentucky, 476 U.S. 79 (1986) (holding that striking jurors solely based on their race violates the Equal Protection Clause of the Fourteenth Amendment). Courts also grant certain latitude to spectators at a trial in displaying emotion. *See generally* Meghan E. Lind, Comment, *Hearts on Their Sleeves: Symbolic Displays of Emotion by Spectators of Criminal Trials*, 98 J. CRIM. L. & CRIMINOLOGY 1147 (2008).

[214] *See* Burch v. Reading, Co. 240 F.2d 574, 577 (3d Cir. 1957).

[215] *Id.*

[216] *Id.*

considered to be a bad sign. Several cases hold robotic behavior in court against the litigant. It may be that cold, calculating people are not viewed as trustworthy; that truth cannot be rehearsed; or that justice is somehow an intrinsically humanistic process.[217] Regardless, we see this sentiment in cases, such as Rong Lin v. Mukasey, where a witness appeared to be "robotically repeating a script rather than testifying from actual experience."[218] We also see it in cases, such as *Kung Lin Chen v. U.S. Department of Justice* in which the witness testified well enough but "appeared 'robotic' when pressed for details on cross examination."[219] Such a finding—often, by an immigration authority—can support an adverse finding as to credibility.[220] Apparently, testifying in court requires some measure of spontaneity, much like a "performance" for purposes of entertainment taxes on food.[221]

C. The Defendant's Robot

The previous two sections focus on behavior taking place within the judicial system. Courts also invoke robots in considering whether to hold parties accountable for conduct that landed them in the system in the first place. Stated simply, the defendant in this scenario describes him or herself as a robot under the control of some operator not before the court. Alternatively, the actions of an entity such as a corporation can be attributed to the defendant because the entity is simply an extension of the person—his or her robot. The idea of a robot becomes synonymous with the absence of autonomy or free will.[222]

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[217] I would pause to note that the standard could be quite different for experts. No case we came across sought to detract from expert testimony on the basis that it felt coached or robotics. Rather, the issue came up in contexts, like asylum cases, where you might expect emotion intensity. Litigants can also try to leverage previous robotic behavior in court for advantage, as when a defendant attempts to withdraw a guilty plea that he delivered "like a robot." United States v. Osei, 679 F.3d 742 (8th Cir. 2012).

[218] 299 F. App'x 10 (2d Cir. 2008).

[219] 195 F. App'x 10, 11 (2d Cir. 2008).

[220] That the cases involving robotic witnesses tend to arise in the context of immigration could be a function of the fact that an immigration court originally came up with the formulation. Or it may reflect something else, such as a language or cultural barrier. *See* infra notes __ to __ and accompanying text (briefly discussing race and gender dimensions to robotics law).

[221] *See supra*, Part I.B.

[222] A note about scope: clearly the notion of free will in philosophy and law has a contentious and involved history. I will not attempt here to unpack whether such a concept exists or what its role should be in legal discourse. Rather, I only call attention to the ways litigants and jurists invoke the concept of robot—apparently, an entity human in appearance but lacking free will—in an effort to avoid or pass through culpability for wrongdoing.

In the 1950 case *Frye v. Baskin*, the plaintiff owned a Jeep that he taught his minor son to drive.[223] His son John was on a date with the defendant, a minor girl, whom John asked to take the wheel. She did not know to drive how but, "under his tutelage," she managed to drive the car around town for a time.[224] At one point, John called out a direction to the girl and then reversed himself, telling her to go right instead of left. She tried to comply and wound up crashing the vehicle.

In the resulting suit by the father against his son's friend, the court refused to find the defendant negligent as a matter of law. According to the court, plaintiff's son John was really the driver.[225] The defendant "controlled the car the same as if she had been a robot or an automaton. When John said 'turn,' she turned, mechanically."[226] She was merely "the instrumentality by which John drove the car."[227] Accordingly, "if it were negligence, it was John's and not hers."[228] Or at least the jury was entitled to so hold.[229]

Molko and Leal v. Holy Spirit Association involved an allegation of false imprisonment against the Unification Church that came before the Supreme Court of California.[230] Plaintiffs claimed inter alia that they were held captive through brain washing until each were captured and "deprogrammed" by professionals sent by their respective parents.[231] Robots do not come up in the majority opinion as such, which allowed the false imprisonment claim to go forward. But the dissent thought the distinction between people and robots to be crucial: "The evidence before us … clearly indicates that the Church's indoctrination did not render appellants mindless puppets or robot-like creatures."[232]

Similar discussions occur in the context of corporate law. A series of cases involved the standing and knowledge of companies that were unwittingly part of a Ponzi scheme. These "captive corporations" were seen as but the "robotic tools" of the scheme's architect.[233] Neither the

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[223] 231 S.W. 2d 630 (Mo. App. 1950).

[224] *Id.* at 633.

[225] *Id.* at 635.

[226] *Id.*

[227] *Id.*

[228] *Id.*

[229] *Id.* at 635 ("Neither does the evidence show negligence on the part of the defendant as a matter of law (if it shows negligence at all, which we need not decide).").

[230] 762 46 Cal. 3d 1092 (1988).

[231] *Id.* at 1101.

[232] *Id.* at 1131 (Anderson, J., concurring in part and dissenting in part.) The dissent cited heavily a 1983 article on whether religious converts were the "robots" of their church, entitled *Of Robots, Persons, and the Protection of Religious Belief* by Robert Shapiro, 56 SO. CAL. 1277 (1983).

[233] Janvey v. Democratic Senatorial Campaign Committee, Inc., 712 F.3d 185, 190-92

corporations nor their investors could be imputed with the knowledge of the scheme. However, once released from the control of the Ponzi scheme, these companies regained their status as separate corporate entities with standing to sue the architect for fraud and other damages.[234]

Conversely, under the "alter ego" theory, a corporation that is merely a defendant's robot is not entitled to treatment as a separate entity.[235] The doctrine says litigants can reach beyond a corporation to the personal assets of a company principal to the extent he or she uses the company to further purely personal interests.[236] But the standard is a high one. The plaintiff must establish that the controlled corporation acted "robot-like" and in "mechanical response" to the controller's "pressure on its buttons."[237] Only then will the court pierce the corporate veil on the alter ego theory.

The idea is that a robot is what a person or entity becomes when completely controlled by another. Such a person or entity is not capable of fault or knowledge, leaving the person behind the machine—the programmer—at fault. The effect is, interestingly enough, temporary. Thus, presumably the defendant who later learns to drive will be responsible for any accident she causes;[238] the victims of a religious cult may be deprogrammed and bring suit;[239] and an entity freed from the robotic control of a Ponzi scheme regains the usual rights of a corporation.[240] While a robot, however, no one sees, hears, or does evil.

III. THE MEANING OF ROBOT CASE LAW

To summarize the argument thus far: robots have played a role in American society for decades, occasionally resulting in interesting legal disputes. These include questions of how and when a robot can be said to represent a person, whether a robot extends people in ways the laws care about, and the conditions under which a person will be responsible for a robot's actions. Not only have robots been at the center of disputes, they have served from their earliest contact with American society as a judicial trope. Judges invoke robots over the decades to describe the limitations and

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(5th Cir. 2013).

[234] *Id. See also* Scholes v. Lehmann, 56 F.3d 750 (7th Cir.1995), *cert. denied sub nom*. African Enter., Inc. v. Scholes, 516 U.S. 1028 (1995)/

[235] *See* Partners Coffee v. Oceana Services and Products, 700 F. Supp. 2d 720, 737 (W.D. Pa. 2010). The alter ego theory should not be confused with the robot Walter Ego from Part I. But it is interesting to see the common verbiage.

[236] *Id.*

[237] Culbreth v. Amosa (Pty) Ltd., 898 F.2d 13, 15 (3d Cir. 1990).

[238] *Id.*

[239] *Id.*

[240] *Id.*

advantages of human beings and to extend and limit a defendant's responsibility for misconduct. The way judges use robots to reason or frame issues may bear on the metaphors and frames they employ to decide cases involving robots and related technology.

In the remainder of the article, I offer some preliminary conclusions regarding the role of robots in American law. The first set involves the direction of the burgeoning field of robotics law and policy. Do past decisions shed light on questions scholars have already explored, such as liability, legal metaphor, and the interplay with race or gender? And do past decisions generate new questions that the field had not considered, such as whether certain legal categories require much greater nuance?

The second set involves the direction of the law itself. Judges appear to hold a very specific mental model of robots as discretionless machines. The model is outdated, if it ever held. This has led to tensions in the case law to date that will only become more acute as sophisticated robot become mainstream. At the same time, a deepening of familiarity with robotics, as well as a diversification in the sources of robot law, may signal a shift toward wiser policy going forward.

A. Robotics Law: An Early Agenda

Legal scholars have been writing about robotics here and there for some time.[241] The recent community around robotics law is especially robust, with a steady drumbeat of new research.[242] Collectively the work spans many different areas. But it tends to take one of several forms. The first is a sustained examination of a particular technology or legal issue. This work might address one or more dimensions of a single technology such drones, driverless, cars, or surgical robots.[243] Alternatively, it may address the intersection of robotics with of one or more of the following issues: (i) civil

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[241] *See, e.g.*, Samuel N. Lehman-Wilzig, *Frankenstein Unbound: Towards A Legal Definition of Artificial Intelligence*, 13 FUTURES (1981). The same is true of other fields. For an early example in economics, see Herbert A. Simon, The Shape of Automation for Men and Management (1965).

[242] This is in part due to the annual robotics law and policy conference colloquially known as "We Robot." The conference is in its fifth year, having been held at Stanford Law School, University of Washington, and twice at the University of Miami. The next We Robot will take place at Yale Law School in the spring of 2017.

[243] *E.g.*, Gregory S. McNeal, *Targeted Killing and Accountability*, 102 GEO. L. REV. 681 (2014) (drones); Ryan Calo, *The Drone as Privacy Catalyst*, 64 STAN. L. REV. ONLINE 29 (2014); Bryant Walker Smith, *Automated Vehicles Are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411 (2104) (driverless cars); Jack Boeglin, *The Costs of Self-Driving Cars: Reconciling Freedom and Privacy With Tort Liability in Autonomous Drone Regulation*, 17 YALE J. L. & TECH. 171 (2015) (same); Julie Goodrich, *Driving Miss Daisy: An Autonomous Chauffer System*, 51 HOUS. L. REV. 265 (2013) (same).

or criminal liability,[244] (ii) legal personhood or agency,[245] (iii) enforcement,[246] (iv) speech and intellectual property,[247] (v) race and gender,[248] and (iv) privacy.[249] Technology or issue specific research is increasingly careful and rigorous and is already adding clarity and shape to the discipline. A limitation of the approach, however, is that it does not necessarily tell us much about the robot of robots *in general* across the law.

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[244] *E.g.*, *See also* PETER M. ASARO, A BODY TO KICK BUT NO SOUL TO DAMN: LEGAL PERSPECTIVES ON ROBOTICS, IN ROBOT ETHICS: THE ETHICAL AND SOCIAL IMPLICATIONS OF ROBOTICS (Patrick Lin et al., eds. 2012); Vladeck, *supra* note 163; Hubbard, *supra* note 163.

[245] *E.g.*, Lawrence B. Solum, *Legal Personhood for Artificial Intelligence*, 70 N.C. L. REV. 1231 (1992); Christopher Stone, *Should Trees Have Standing? Revisited: How Far Will Law and Morals Reach? A Pluralist Perspective*, 59 S. CAL. L. REV. 1, 14 (1985) (discussing whether a robot could have standing); Steven Goldberg and Nancy Cruzan, *The Changing Face of Death: Computers, Consciousness*, 43 STAN. L. REV. 659 (1991); F. Patrick Hubbard, *'Do Androids Dream?': Personhood and Intelligence Artifacts*, 83 TEMP. L. REV. 405 (2011); SAMIR CHOPRA & LAURENCE F. WHITE, A LEGAL THEORY FOR AUTONOMOUS AGENTS (2011).

[246] *E.g.*, Lisa A. Shay et al., *Confronting Automated Law Enforcement*, in ROBOT LAW (Ryan Calo, A. Michael Froomkin, and Ian Kerr, eds., 2016); Elizabeth E. Joh, Discretionless Policing: Technology and the Fourth Amendment, 95 CALIF. L. REV. 199 (2007).

[247] For discussion of intellectual property, see, e.g., Annemarie Bridy, *Coding Creativity: Copyright and the Artificially Intelligent Author*, 2012 STAN. TECH. L. REV. 5, 21 (2012); Ralph D. Clifford, *Intellectual Property in the Era of the Creative Computer Program: Will the True Creator Please Stand Up?*, 71 TUL. L. REV. 1675, 1696-97 (1997) (arguing that patent law implicitly assumed a human inventor); Pamela Samuelson, *Allocating Ownership Rights in Computer-Generated Works*, 1185 U. PITT. L. REV. 47 (1985). For discussion of free speech, *see, e.g.*, Tim Wu, *Machine Speech*, 161 U. PENN. L. REV. 1495, 1496 (2013) ("The question of 'rights for robots,' if once limited to science fiction, has now entered the public debate."); Stuart Minor Benjamin, *Algorithms and Speech*, 161 U. PENN. L. REV. 1445 (2013).

[248] *E.g.*, Sinziana M. Gutiu, *The roboticization of conse*nt, in ROBOT LAW (Ryan Calo, A. Michael Froomkin, and Ian Kerr, eds., 2016); Ann Bartow, *Robots as Labor Creating Devices: Robotic Technologies and the Expansion of the Second Shift*, Proc. We Robot 2014, Apr. 4, 2014; Peter A. Asaro, *Will Black Lives Matter to Robocop?*, Proc. We Robot 2016, Apr. 1, 2016.

[249] *E.g.*, Margot E. Kaminski, *Robots in the Home: What Will We Have Agreed To?*, 51 IDAHO L. REV. 661 (2015); Ryan Calo, *Robots and Privacy, in Robot Ethics: The Ethical And Social Implications of Robotics*, 195 (Patrick Lin et al., eds. 2012).

In addition, scholars work in related areas such as the effect of automation on the legal profession and the prospect of accountability and impartiality in the design and implementation of algorithms. *E.g.*, Daniel Martin Katz, *Quantitative Legal Prediction—Or—How I Learned to Stop Worrying and Start Preparing for the Data Driven Future of the Legal Services Industry*, 62 EMORY L.J. 909 (2013); FRANK PASQUALE, THE BLACK BOX SOCIETY: THE SECRET ALGORITHMS THAT CONTROL MONEY AND INFORMATION (2015); Solon Barocas and Andrew D. Selbst, *Big Data's Disparate Impact*, 104 CALIF. L. REV. (forthcoming 2016).

The work it does is more specific.

Other research takes a step back and looks at the larger context of robotics law and policy. The advantage, arguably, of treating robotics as a broader phenomenon is that one sees connections across robots and legal domains. For example, the degree of control people exert over a robot could come up as an issue as easily in tort law (vicarious liability, res ipsa loquitur) as in the international law of the sea.[250] The issue with an approach that is less specific is that it also tends to be more speculative. The consensus among commentator is that robots will, someday, create legal and policy puzzles of a certain kind.[251] But we do not necessarily know in advance what they will be and, accordingly, we will be hard-pressed to identify models or solutions.

Consider again the conversation from the Introduction. Jack Balkin argues we cannot know how courts and others view robots.[252] Hence, we must wait and see to get a sense of what issues they will raise.[253] There is truth to Professor Balkin's claim: robotics is certainly advancing at a rapid pace and more and more people are coming into contact with robots outside of the contexts of manufacturing or warfare. The results for law and society are difficult to anticipate. What this article shows, however, is that robots have already raised specific and interesting issues that current technological trends stand to enhance. Focusing on these issues not only helps us understand how the law will come to mediate the mainstreaming of robotics, but it also suggests or grounds questions for the burgeoning field.

One example is the role of metaphor in judicial reasoning, already raised in the lead in to Part II. We sense that the metaphor or analogy a court or policymaker choses to adopt around a new technology can influence its fate.[254] Thus, for example, thinking of email as analogous to a postcard could lead to less Fourth Amendment protection than thinking of email as analogous to a letter.[255] Believing encryption to be a form of speech could lead to First Amendment pushback should government seek to regulate encryption.[256]

Students of robotics law have not missed the importance of metaphor. Law professor Neil Richards and roboticist William Smart, for example,

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[250] Calo, *supra* note 8, at 543-44 (discussing the concept of exclusive control in these contexts).

[251] *See*, *e.g.*, Lehman-Wilzig, *supra* note 241. *See also supra*, note 245.

[252] Balkin, *supra* note 12, at 45.

[253] *Id.*

[254] *See supra*, notes __ to __ and accompanying text.

[255] The Department of Justice has made this argument with mixed success. *See* SUSAN W. BRENNER, CYBERCRIME AND THE LAW: CHALLENGES, ISSUES, AND OUTCOMES 158 (2012).

[256] Froomkin, *supra* note 193, at 879.

expressly call attention to the importance of metaphor and legal analogy in their work *How Should the Law Think About Robots?*[257] These authors conclude that courts should be careful to characterize robots as tools, albeit programmable ones, because doing otherwise runs the risk of committing what the authors call the Android Fallacy.[258] Two strengths of Richards and Smart's work are their recognition that metaphor matters and their sober-eyed examination of the present state of the technology. A weakness is that their failure to imagine the ways robots do and will depart from the mental model they urge.

The case studies in Parts I and III may help us predict the sorts of metaphors judges are likely to select. More specifically, the case studies suggest that judges already think of robots as no more than programmable (or teleoperated) tools.[259] This is not necessarily ideal in all circumstances. For example, while it may be appropriate to hold the pilot accountable for failing to supervise the rudimentary robotic pilot of *Brouse v. United States*,[260] perhaps judges should resist the inclination to attribute liability a person whenever he or she happens to be in the loop. We may not wish to incentivize the preservation of human control, even where less safe or efficient, merely to furnish a human "crumple zone" for liability.[261] I am aware that the liability still winds up landing on one or more humans—perhaps the manufacturer of the driverless car instead of whoever happens to be behind the skeuomorphic wheel. Even so, the metaphors and analogies we use influence *which* human pays the price for a robotic harm.

The case studies may inform other areas of scholarship as well. Consider the small but powerful literature surrounding the role of robotics in race and gender law.[262] Just as Jeannie Suk asks whether privacy is a woman,[263] robotics law and policy scholars may ask whether *Frye v. Baskin*—the case of the robotically driven Ford—comes out the same way

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[257] Neil Richards and William Smart, *How Should the Law Think About Robots?*, in ROBOT LAW 3 (Ryan Calo, A. Michael Froomkin, and Ian Kerr, eds., 2016). *See also* Meg Leta Jones and Jason Millar, *Hacking Analogies in the Regulation of Robotics*, in OXFORD HANDBOOK OF THE LAW AND REGULATION OF TECHNOLOGY (Karen Yeung, Roger Brownsword, and Eloise Scotford, ed. 2016).

[258] Richards and Smart, *supra* note 257, at 4 ("Finally, we argue that one particularly seductive metaphor for robots should be rejected at all costs: the idea that robots are 'just like people'… We call this idea 'the Android Fallacy.'").

[259] *See supra* Parts I and II.

[260] 83 F. Supp. 373, 374.

[261] *See* Madeleine Elish, *Moral Crumple Zones: Cautionary Tales in Human Robot Interaction*, Proc. We Robot 2016, Apr. 1, 2016 (exploring the potential that people will be kept in otherwise fully autonomous systems for the sole purpose of absorbing liability).

[262] *See supra*, note 248 (listing examples).

[263] Jeannie Suk, *Is Privacy A Woman?*, 97 GEO. L. REV. 486 (2009).

if the gender of the litigants were reversed.[264] Would a court, particularly in 1950, find that a boy who could not drive was the robot of the girl who could? Scholars could also explore why the Ninth Circuit's example of a robot mostly clearly representing a person involves a robot Michael Jordan,[265] or whether there is anything to Judge Higginbotham's contention that black judges are expected to be robots where white judges are not,[266] and why it is that that the concern over robotic testimony appears first and most often in the context of immigration.[267]

The preceding case studies not only illuminate existing debates, but hint at entirely novel questions scholars of robotics law and policy might explore. The literature speculates considerably as to who or what is to blame when a robot causes harm. It also grapples with whether the law should recognize legal, market, or intellectual behaviors initiated or executed by robots. Papers in the first category might ask whether the passenger or the manufacturer is responsible for a car accident in a driverless car.[268] Papers in the latter might investigate whether an artificial intelligence can act as a trustee, make a binding contract, or "create" an original work.[269]

There is next to no scholarship, however, tackling several of the very questions with which the courts already struggle. These tend to involve deep questions around the differences between people and machines. One question that remains untheorized in the early literature, for instance, is whether and to what extent a robot can represent a person. When you take or draw a picture of a person, it represents her.[270] But when you build a robot version of a person, does it represent the person in the same way? The Ninth Circuit at best equivocates, finding robots to represent people for purposes of common but not statutory law, though identically phrased.[271]

There is a similar struggle in the cases attempting to characterize robots for purposes of trade law. The court in *Louis Marx & Co.*, examining the tariff schedule for a windup toy, itself winds up in a dubious position that would likely benefit from scholarly engagement within and beyond the legal academy.[272] The court acknowledges that robots are machines that

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[264] 231 S.W. 2d 630.

[265] White, 971 F.2d 1395, 1399.

[266] Local Union 542, Int. Union of Op. Eng., et al., 388 F. Supp. 155, 180.

[267] *See supra*, notes 217-21 and accompanying text (listing cases).

[268] *See supra*, note __.

[269] *E.g.*, Solum, *supra*, note 245; Ian Kerr, *Ensuring the Success of Contract Formation in Agent-Mediated Electronic Commerce*, 1 ELECTRONIC COMM. R.J. 183-202 (2001); Bridy, *supra* note 247.

[270] [cite]

[271] *See supra*, 39-42 and accompanying text (citing White, 971 F.2d at 1395).

[272] 40 Cust. Ct. 610.

represent men—it consults a dictionary that says so—but nevertheless concludes that robot toys only represent robots, which are just machines.[273] There is even some tension between the appropriation cases and the cases involving tariffs. In the former, human features mean a robot can come to represent a person.[274] But in the latter, human features like those of the astronaut in *Lewis Galoob Co.* do not necessarily detract from its characterization of a robot.[275]

Another puzzle involves whether and under what circumstances a person operating a robot can be said to exist in the places to which the robot travels. I have highlighted two case studies—one involving claims to a particular right at sea, the other involving responsibility for the crime of entering a dwelling with intent to steal.[276] Thus, a court sitting in maritime generated a new category of possession to accommodate the changing nature of undersea exploration.[277] And a criminal court found that while a person can burglarize a bank with a metal robot, he cannot do so with a paper check.[278]

But there are myriad areas of law where this question could arise. One such area is space law. Recently the United States, with the passage of the US Commercial Space Launch Competitiveness Act of 2016, adopted the position that American individuals or companies who extract resources from an asteroid or the moon are free to alienate those resources.[279] Presumably two or more teams might compete for the right to mine the same extraterrestrial resource. Another area is remote or autonomous robotic surgery, which could raise questions of whether and where an operator or programmer must be board certified in order to perform a procedure in any given state.[280]

The issues presented are many and interesting. Do we allow persons to use a robot to extend themselves to new places only when a person cannot safely enter the environment? *Columbus America*, the case announcing the

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[273] *Id.*

[274] *See* Wendt, 125 F.3d at 809 (permitting the lawsuit to go forward under California law because, unlike in White, the robots had molded skin like actual people).

[275] *See* Lewis Galoob Co., 66 Cust. Ct. at 486 ("[T]he presence of a human face in an article which is otherwise incapable of representing any living being cannot make 'animate' what is, in totality, incapable of animation or life.").

[276] *See* Parts I.D and I.E.

[277] *See* Columbus-America Discovery Group, Inc, 742 F.Supp. at 1328-29.

[278] *See* Davis, 958 P.2d 1083.

[279] H.R.2262, Public Law No: 114-90 (2015-2016).

[280] The first issue is similar to the kinds of problems of jurisdiction that the Internet created. If a surgeon in Maryland is operating on a patient in Ohio, must she be certified in Maryland, Ohio, or both? The second issue—presented, for instance, by Google's partnership with Johnson & Johnson to develop autonomous surgery robots—is whether the robot would need to be certified at all, let alone where.

doctrine of tele-possession, leaves this question open by limiting itself to the dangerous context of the high seas.[281] How much control must a robot afford over an environment for the person operating the robot to legally (or illegally) enter the space? What if there is a time delay between the command and its execution? What if the actions constitute a blend of human and machine control, or the work of many operators together as the case with military drones?[282]

Answering these and related questions in depth is outside the scope of this article. Nevertheless, the courts have already had to grapple with some of the difficult questions robots tend to spur, questions altogether outside of the existing legal literature. If these past cases are prologue, similar issues are on the horizon. And the robotics law and policy community is well-positioned to begin to lend analytic rigor to the debates.

B. Law and Contemporary Robotics

The bulk of this article is devoted to showing how courts have already come to grapple with robots in various ways. Robotics today is in the midst of a sea change, advancing at a breakneck pace. The field is headed toward a Cambrian explosion, referring to the great speed of the field's evolution and diversification.[283] What can the way courts have talked about robots in the past tell us about their reaction to this old but newly transformative technology? And how are we to proceed if we are to fashion a wise robotics law and policy going forward?

A path toward understanding how contemporary robots will interact with the law involves grappling with the differences and similarities between robotics today and the robots the law has already met. Such an exercise is crucial, both because the introduction of vastly more robots into society will amplify the effect of judicial mistakes regarding the technology, and because the technology itself has evolved past what the doctrine contemplates.

Elsewhere I explore what I consider to be the three main qualities of robotics that pose particularly interesting legal and policy challenges.[284] The preceding case studies support my older arguments to a degree. For instance, I argue that the unique social valence of robots, i.e., the ways we are hardwired to react to a robot as though it were a social being, will pose

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[281] Columbus-America Discovery Group, Inc, 742 F.Supp. at 1328-29

[282] For a discussion of blended control, see Meg Leta Ambrose, *The Law and The Loop*, Proc. IEEE Ethics (2014).

[283] Gill A. Pratt, *Is a Cambrian Explosion Coming for Robotics?*, 29 J. ECON. PERSP., 51 (2015).

[284] Calo, *supra* note 8.

novel challenges for law and policy.[285] And courts have indeed struggled with the ways robots might be surrogates for people beyond what one might expect with another technology. I also argue in past work that the physical embodiment of software code will play an important role in determining liability.[286] This claim sees modest support in the greater willingness of courts to assign blame to a person when that person relies on a robot in a way that leads to physical harm.

What I found most striking in my review of the case law, however, is how uniformly courts reject the prospect of emergent robot behavior. Emergence refers to the ability or tendency of a system to behave in complex, unanticipated ways.[287] Emergence has long been a gold standard in robotics.[288] The idea is to create robots that do not need to be programmed to solve tasks, at least not in the same way as an entirely bounded system. They can learn from experience and solve problems in ways their creators never envisioned.

This capacity for surprise, of course, is double-edged. It can result in a more efficient warehouse,[289] a new invention,[290] or an unanticipated style of game play.[291] But it can also result in making people feel threatened or under assault. For example, police in Amsterdam investigated the designer of a Twitter bot—an autonomous software agent on the Internet—when it appeared to threaten harm to a local fashion show.[292] The bot threat had a real world impact through the show's concern about potential violence and the costs of a police investigation. Where a system is embodied, i.e., has the capacity physically to affect the world in itself, emergent behavior can result in actual bodily harm. Even absent embodiment an emergent system can threaten critical aspects of society, as when high-speed trading

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[285] *Id.* at 545-49. *See also* Calo, *supra* note 249 (discussing social valence in the context of privacy).

[286] Calo, *supra* note 8, at 532-37. *See also* Calo, *Open Robotics*, *supra* note 167.

[287] Calo, *supra* note 8, at 539 (citing STEVEN JOHNSON, EMERGENCE: THE CONNECTED LIVES OF ANTS, BRAINS, CITES, AND SOFTWARE 18-19 (2001)).

[288] *Id.* at 538-39.

[289] *See supra* notes 5 and 86 (discussing Amazon's use of robots).

[290] ROBERT PLOTKIN, THE GENIE IN THE MACHINE: HOW COMPUTER-AUTOMATED INVENTING IS REVOLUTIONIZING LAW AND BUSINESS 51-52 (2009) (describing the "Creative Machine" that the company Gillette used to redesign its toothbrush). IBM's Watson, an artificial intelligence engine that beat the top Jeopardy players in an exhibition match, also generates new food recipes. The Bengali Butternut BBQ Sauce is pretty good.

[291] Deep Mind, an artificial intelligence company owned by Google, has taught an algorithm to play multiple Atari games. Often the style of play differs from that of the best gamers, even as it breaks all high scores.

[292] *See* Kashmir Hill, *Who do we blame when a robot threatens to kill people?*, FUSION, Feb. 15, 2015, http://fusion.net/story/48656/who-do-we-blame-when-robots-threaten-to-kill-people/.

algorithms destabilize the stock market.[293]

From my study of how courts talk about robots, both in deciding cases about robots and in invoking the technology in the course of judicial reasoning, judges have a specific model of robots in mind. In American law to date, the robot is by definition a programmable machine.[294] It does exactly what its programmer tells it to do. It follows that a robot cannot be spontaneous enough to perform in a restaurant or responsible for the collision between two airplanes.[295] And it follows further that a person who acts like or is similar to robot is not responsible for his or her own actions.[296]

The idea that a robot can only follow its programming is, on one level, correct. Robots do not somehow "decide" how to act, and they are not capable of deviating from the code that constitutes them. But judicial understandings of robots are also fundamentally wrong in crucial respects. Even if a robot will always run its code, that does not mean that a programmer anticipates, let alone intends, every action the robot takes. People can and do program robots to interact dynamically with their environment and to generate and attempt new solutions.[297] Part of the very appeal of these systems is that they come up with novel strategies and results by approaching problems in a way no human would.[298]

Courts have yet to come into significant contact with emergent systems. When they do, judges will have to shed their current conceptions of the technology or they will make analytic mistakes. Thus, while the research underpinning this article corroborates several of my earlier hypotheses, it amends others. I have assumed courts confronted with emergent behavior will recognize that its creators did not foresee or intend the behavior.[299] The logical step would be the refusal to find the necessary mens rea in criminal law or foreseeability in tort, leading to would-be prosecutors with no defendants and victims without redress.[300]

My recent research convinces me that courts may assume this problem away for a time. The idea that robots do the specific bidding of people appears firmly ingrained in the judicial imagination. Confronted with an emergent mishap, courts may lay blame with the creator or operator no matter what they arguments these defendants deploy. There are, perhaps,

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[293] *See* Calo, *supra* note 8, at 541 (citing Tom C.W. Lin, *The New Investor*, 60 UCLA L. REV. 678 (2013)).

[294] This definition is still popular in certain disciplines such as electrical engineering.

[295] *See supra* Parts I.B and I.E.

[296] *See supra* Part II.C.

[297] *See* Calo, *supra* note 8, at 538.

[298] *Id.*

[299] *Id.* at 541-45, 554-55.

[300] *Id.* at 554-55.

advantages to this approach. But the disadvantages are also significant. As the Supreme Court recently reaffirmed, the Constitution frowns on using even negligence as the intent standard for crimes.[301] And the approach in tort would go beyond even strict liability, where courts dispense with an inquiry into fault but nevertheless require foreseeability to satisfy proximate causation.[302]

The preceding raises an interesting institutional question: who should decide how law evolves with robotics? Another difference today, beyond advances in technology, is that officials other than the judiciary have become primary sources of robotics policy. Increasingly, legislatures and agencies are passing rules about robots. A full accounting for these laws is beyond the scope of this particular article. But just a few examples include dozens of state laws regulating driverless cars, the domestic use of drones, and insurance for telemedicine.[303]

These laws are not necessarily wise or perfectly informed. The state of Nevada had to repeal and rewrite its pioneering driverless car legislation within a year because of an unanticipated impact on automakers.[304] But the new laws demonstrate that the courts are not the only place where robotics law and policy is made. A plausible scenario suggests that federal and state lawmakers wind up setting the new tone, tenor, and content of robotics law. Recently, the National Highway Transportation Safety Administration responded to Google's request to clarify whether driverless car software could quality as a "driver." The NHTSA responded that, under certain circumstances, software could be a driver—an opinion likely to influence other judicial, regulatory, and legislative bodies down the line.

New legal institutions could play a role. Agencies famously serve as repositories of expertise.[305] I and others argue in favor of a new technology commission, a kind of NASA-for-everything that can act as a repository of knowledge about robots to guide legal actors, including courts.[306] This

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[301] Elonis v. United States, 575 US. __, at *13-14 (2014) (rejecting a negligence standard in a criminal case).

[302] Calo, *supra* note 8, at 554-55.

[303] *E.g.*, S.B. 1298, 2012 Leg., Reg. Sess. (Cal. 2012) (authorizing autonomous vehicles); A.B. 511, 2011 Leg., 76th Sess. (Nev. 2011) (same); S.B. 313, 2013 Leg., 77th Sess. (Nev. 2013) (regulating autonomous vehicles); S.B. 1134, 62nd Leg., 1st Reg. Sess. (Idaho 2013) (placing limits on domestic use of drones); S.B. 1587, 98th Gen. Assemb., Reg. Sess. (Ill. 2013) (same); Va. Code § 38.2-3418.16 (requiring insurance to cover telemedicine).

[304] NRS § 482A.020 (repealed 2013); NRS § 482A.30 (2011).

[305] *See* Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc. 467 U.S. 837, 866 (1984).

[306] *See* Ryan Calo, *The Case for a Federal Robotics Commission* (2014), http://www.brookings.edu/research/reports2/2014/09/case-for-federal-robotics-commission; Bruce Schneier, *The Internet of Things Will Be the World's Biggest Robot*,

article focuses on case law because state and federal courts have been the main points of contact between robots and the law in the past half-century. New configurations are always possible.

The mental models of judges may also change with time. Robotics experts may come before the court; technically minded organizations and individuals may file amicus briefs. In several of the cases in Part I, we see the court turning to the dictionary.[307] This is interesting insofar as the definition of a robot changes with the time. Thus, imagine if the court in [insert case] were to apply the contemporary definition of a robot as a "machine that looks like a human being and performs various complex acts (as walking or talking) of a human being" to the toy under examination.[308] But as we have also seen, courts are perfectly capable of ignoring definitional elements that go against their intuitions about the technology.[309]

The broadening of sources of robotics law may prove a good or bad thing.[310] Lawmakers and agency officials may be better positioned than courts to gain the expertise and appreciation of just how far robots has come, or else introduce new and unwelcome complexities. New policy frameworks, coupled with good experts and amicus briefs, could, on a charitable reading, help update the mental models of courts and lead to analytically sound outcomes. Here I agree with Professor Balkin: we will only understand the true impact of robots on American law and legal institutions in the fullness of time.

CONCLUSION

This article offered nine new case studies to illuminate the role of robots in American law. The first set considered robots as *objects* of American law, i.e., as artifacts in the world that have occasioned legal disputes. The second set considered robots as *subjects* of the judicial imagination, i.e., as metaphors or similes that support a particular verdict. Few of the decisions that make up these studies appear in the legal literature to date—even within the burgeoning field of robotics law.

Examining these cases together yields a series of valuable insights. One is that robots tend to blur the line between person and instrument. A robot is an artifact, but one holding special fascination and significance. Courts have

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FORBES (Feb. 2, 2016), http://www.forbes.com/sites/bruceschneier/2016/02/02/the-internet-of-things-will-be-the-worlds-biggest-robot/#27d41a853162.

[307] *See supra*.

[308] "Robot." *Merriam-Webster.com. Merriam-Webster*, n.d. Web. 10 Feb. 2016.

[309] *See supra*.

[310] For a recent argument that courts are surprisingly well-positioned to cultivate expertise, see Elizabeth Fisher et al., *Rethinking Judicial Review of Expert Agencies*, 93 TEXAS L. REV. 1681 (2015).

struggled with the status of robots, asking how robots can be said to represent, imitate, extend, or absolve people. Judges also invoke robots in a variety of contexts when a person is acting, or being asked to act, outside of the typical bounds of a human being.

A second is that judges may have a problematically narrow conception of what a robot is. There are, unsurprisingly, conflicts and tensions in early robot law. Courts are ambivalent about each of the questions they confront and results vary with context. But there seems to be an odd consensus with respect to the judge's mental model of a robot: it is a programmable machine, by definition incapable of spontaneity.

If this definition or robots were ever true, it is not true today. Contemporary robots range in sophistication, with some systems solving and creating problems in ways never the programmer nor the public would have anticipated. The mismatch between what a robot is and how courts are likely to think of robots will only grow in salience and import over the coming decade.

The story of robots and the law is only beginning. Robots are rapidly entering the mainstream and are likely to alter the legal landscape in ways prosaic and profound. But we should not assume we write on a clean slate. Robots have been a part of American society for half a century. And as the preceding pages show, they have already generated a limited but significant body of law that awaits exploration.