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CHAPTER

25 Hacking Metaphors in the Anticipatory Governance of Emerging Technology: The Case of Regulating Robots

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Abstract

Metaphors are essential tools for helping us to interpret new technologies, integrate them into our daily lives and govern them appropriately. Metaphors link the unfamiliar to the familiar. However, metaphors are often partial and unstable, especially in their application to emerging technologies, such as robots—robots are here, but we have yet to decide on the many roles that robots will occupy in society. Metaphors also tend to promote certain values over others. Applying a particular metaphor to a technology thus casts that technology in a political role. In this chapter, we promote metaphor hacking, a playful and practical methodology for identifying and analysing potential metaphors that might be applied in the governance of technology. We argue that metaphor hacking allows us to anticipate some of the governance and ethical issues that could emerge around a technology owing to the metaphors we choose for describing them.

Keywords: technology metaphors, design, robotics, robot ethics, driverless cars, robotics policy, robotics law, analogical reasoning

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1. Introduction

ROBOTS have arrived, and more are on the way. Robots are emerging from the cages of factory floors, interacting with manufacturing and warehouse workers, converging on lower airspaces to deliver goods and gather information, replacing home appliances and electronics to create connected, 'smart' domestic environments and travelling to places beyond human capacity to open up new frontiers of discovery. Robots, big and small, have been integrated into healthcare, transportation, information gathering, production, and entertainment. In public and private spaces, they are changing the settings and dynamics in which they operate.

p. 598 There is no concise, uncontested definition of what a 'robot' is. They may best be understood through the sense–think–act paradigm, which distinguishes robots as any technology that gathers data about the environment through one or more sensors, processes the information in a relatively autonomous fashion, and acts on the physical world (Bekey 2012). Though this definition generally excludes software and computers from the robot family (despite their ability to sense and interact with the world through user interfaces), the line between any artificial intelligence (AI) and robots is blurred in part because many of the ethical and governance issues arising in the context of robotics also arise in the context of AI (Kerr 2004; Calo 2012).

We are still in the beginning of the robotic revolution, which has been predicted to occur in various ways and to proceed at various paces. Microsoft founder Bill Gates (2007) stated, '[A]s I look at the trends that are now starting to converge, I can envision a future in which robotic devices will become a nearly ubiquitous part of our day-to-day lives.' Rodney Brooks (2003) explained that the robotics revolution is at its 'nascent stage, set to burst over us in the early part of the twenty-first century. Mankind's centuries-long quest to build artificial creatures is bearing fruit.' The Obama administration's National Robotics Initiative 'is accelerating innovations that will expand the horizons of human capacity and potentially add over $100 billion to the American economy over the next decade' (Larson 2013). The European Commission partnership with the robotics community, represented as euRobotics aisbl, claims, 'robotics technology will become dominant in the coming decade. It will influence every aspect of work and home' (euRobotics AISBL 2013).

There are currently no regulatory regimes specifically designed for robots. Rather, robots fall within the general laws of civil and criminal liability (Karnow 2015). Robots are considered tools that humans use, and those humans may or may not be held accountable for using a robot, except where there are specific legislative provisions in place like the Federal Aviation Administration's temporary ban on the commercial use of drones, or the handful of states that have passed specific laws to address driverless cars. The disruptive nature of robotics challenges legal and ethical foundations that maintain and guide social order (Calo 2015; Millar and Kerr 2016). These predictions of regulatory disruption lead to anticipatory governance questions like 'What should we be doing to usher in and shape the oncoming robotic revolution to best serve the environment and humanity?', 'How should designers, users, and policymakers think about robots?', and 'Is there a need for new ethics, policies, and laws unique to robotics?'. Anticipatory governance is a relatively new approach to social issues connected with technological change; it recognizes the futility of regulating according to a precise predicted future. Instead anticipatory governance embraces the possibility of multiple futures and seeks to build institutional capacity to understand and develop choices, contexts, and reflexiveness (Sarewitz 2011).

Metaphors matter to each of these questions, and so one can use them in anticipatory governance.
p. 599 Technological metaphors are integral to the creative inception, ↳ user-based design, deployment, and potential uses of robots. As we further integrate robotics into various aspects of society, the metaphors for making sense of and categorizing robots will be questioned and contested as their political outcomes are

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revealed. The design and application of robots will contribute to the way we understand and use robots in light of existing technologies and expectations, while law and policy will use metaphors and analogical reasoning to regulate robots in light of existing rules and doctrine. Anticipating the metaphors designers and users might employ will help guide policy, but is steeped in uncertainty. This chapter critically interrogates the role that metaphors play in the governance of emerging technologies, and considers how technological metaphors can be chosen to drive governance that accomplishes normative goals.

2. The Instability of Metaphors in Robotics Law, Policy, and Ethics

In her wildly successful IndieGoGo fundraising video, MIT roboticist Cynthia Breazeal claims that her latest social robotics creation—Jibo—is 'not just an aluminium shell; nor is he just a three-axis motor system; he's not even just a connected device; he's [pause] one of the family' (2014). Metaphors like 'family member' play a fundamental role in framing our understanding and interpretation of technology. In choosing to describe Jibo as a family member, Breazeal simultaneously anthropomorphizes Jibo, making 'him' seem human-like, and places him in the centre of the family, an intimate social unit. She constructs the metaphor by presenting a montage of scenes featuring Jibo interacting with a family during birthday parties and holiday gatherings, one-on-one helping the family matriarch while in the kitchen (the heart of the home) and even as storyteller during the youngest daughter's bedtime. Jibo is presented as a reliable, thoughtful, trusted, and active family member.

Breazeal's video is clearly a pitch aimed at raising capital for Jibo, Inc, an expensive technology project. But to consider it merely a pitch would be a mistake. The success of the video underscores the power of metaphors to frame the meaning of a technology for various audiences. News stories covering the fundraising campaign further entrenched Jibo's public preproduction image by echoing Jibo's family member metaphor, one article going so far as to suggest Jibo as a kind of cure for loneliness (Baker 2014; Clark 2014; Subbaraman 2015). Jibo exceeded its fundraising goals within a week, ultimately raising over $2m in less than a month (Annear 2014). Whether or not Breazeal and her team have oversold a technology
p. 600 remains to be seen—Jibo may or may not succeed in fulfilling users' expectations as a family member. ↳ Regardless, the Jibo case exemplifies how metaphors can play an important role in framing the way the media and consumers come to understand and interpret a technology. It follows that metaphors can also frame how designers, engineers, the law, and policymakers understand and interpret technology (Richards and Smart 2015).

Whether or not Jibo is best described as a family member is, to an important degree, an unsettled question that will depend largely on who is choosing to describe it, and what their values and interests are. One could select another metaphor for Jibo. Though a successful metaphor will undoubtedly highlight salient aspects and features of a technology, the picture depicted by any metaphor is often partial, and often emphasizes particular values held by those offering it up (Guston 2013). Thus, the metaphor a person uses to describe a technology will depend on her goals, interests, values, politics, and even professional background. In this sense metaphors are contextually situated, contested and unstable.

Several competing and overlapping metaphors are emerging in the literature on robotics law, policy, and ethics, which help to underscore their contextual nature, contestedness, and instability.

Richards and Smart (2015) argue that for the foreseeable future, robots should be understood as mere 'tools', no different to hammers or web browsers. As tools, robots are meant to be understood as neutral objects that always, and only, behave according to the deterministic programming that animates them. Adopting the tool metaphor can be a challenge, they argue, because of common competing metaphors that invite us to think of robots as anything but mere tools. In movies and other popular media robots are quite often depicted as having unique personalities, free will, emotionally expressive faces, arms, legs and other

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human-like qualities and forms in order to provide an emotional hook that draws the viewer into the story. And it seems all too easy to succeed in drawing us in. Robots are often successfully depicted as friends, lovers, pets, villains, jokers, slaves, servants, underdogs, terrorists, and countless other human or animal-like characters. Research has shown that humans tend to treat robots (and other technology) as if they have human or animal-like qualities—we anthropomorphize robots—even in cases where the robot's behaviour is extremely unsophisticated (Duffy 2003). Even designers and engineers, who 'ought to know better', are found to be quite susceptible to anthropomorphizing tendencies (Proudfoot 2011). Despite the many challenges posed by our psychology, Richards and Smart (2015) insist that when we anthropomorphize a robot we are guilty of adopting an inaccurate metaphor, a mistake they call the android fallacy. One commits the android fallacy whenever they make assumptions about a robot's capabilities based on its appearance. The android fallacy usually involves assuming a robot is more human-like than it is. According to Richards and Smart, committing the android fallacy in the context of law and policymaking can be 'inappropriate' and even 'dangerous' (2015). The android fallacy, they say, 'will lead us into making false assumptions about the capabilities of robots, and to think ↳ of them as something more than the machines that they are' (Richards and Smart 2015, 24). Thus, in order to get the law right we must adopt the 'tool' metaphor and 'avoid the android fallacy at all costs' (Richards and Smart 2015, 24). We must govern according to the robot's function, not its form.

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Richards and Smart would likely balk at the suggestion that Jibo is best understood as a family member. For them, to apply that metaphor to Jibo would be a straightforward example of the android fallacy, with problematic legislation and policy certain to follow. However, despite their insistence that any metaphor other than 'tool' would amount to a misunderstanding of technology, the 'tool' metaphor is but one of many choices one can adopt in the context of robotics.

Breazeal, for example, has expressed frustration with those who refer to social robots as slaves or mere tools (Baker 2014). Though her IndieGoGo video focuses on the family member metaphor, she argues that a well-designed social robot is best thought of as a 'partner'. Tools, being designed with individual users and specific tasks in mind, 'force you to leave the moment', whereas a partner like 'Jibo … will allow you to access all [your] information and technology while you stay in the moment—while you stay in your life' (Baker 2014). In contrast to Richards and Smart's legal perspective, Breazeal's design perspective insists on the partner metaphor while imagining complex groups of users and rich social contexts within which the robot will be actively situated. Describing Kismet, one of her first social robotics creations, Breazeal says

> Kismet had a lot of charm. When you create something like a social robot, you can experience it on all these different levels. You can think about it from the science standpoint and the engineering standpoint, but you can experience it as a social other. And they're not in conflict. When Kismet would turn and look at you with its eyes, you felt like someone was at home. It was like, I feel like I'm talking to someone who is actually interpreting and responding and interacting with me in this connected way. I don't feel like it's a dead ghost of a shell. I actually feel the presence of Kismet.
>
> (Baker 2014)

The differences between these two perspectives demonstrate how different values and worldviews anchor each competing metaphor. From the perspectives of a lawyer and an engineer, the partner metaphor seems to fail for its inability to anticipate legal and regulatory quagmires that would complicate the law. According to a social robotics engineer, the tool metaphor fails for its inability to acknowledge and anticipate good and meaningful user experiences. Worse, it denies the social bond that can be instantiated between a human and a robot. Each perspective, and its accompanying choice of metaphor, captures a different aspect of the same technology, emphasizing the values that aid in achieving some normative goal.

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The tool metaphor is not the only one suited to a legal perspective. Richards and Smart argue that the deterministic nature of computer programs gives us good reason to adopt the tool metaphor: deterministic programs seem to allow us to predict a robot's behaviour in advance and explain it after the fact. However,
p. 602 many current ↳ and next-generation robots are being designed in such a way that their behaviour is unpredictable (Millar and Kerr 2016). Their unpredictability stems in part from the fact that they are designed to operate in open environments, which means the set of inputs feeding the deterministic programs are constantly shifting. Though they are predictable in principle, that is, in cases where all of the inputs and the current state of the program are known, the reality is that knowing that information in advance of the robots acting is not practically feasible. Moreover, unpredictability by design is becoming more and more common because it enables robots to operate in real-world environments with little constraint—unpredictability by design helps to make robots more autonomous.

Unpredictability can directly challenge the tool metaphor in a legal context, especially when a robot is designed to be unpredictable and social. Consistent with Breazeal's description of Kismet, our interactions with social robots tend to lead us to think of them more like individual agents than tools. In fact, humans seem to be psychologically wired in such a way that a robot's social emergent behaviour makes it very difficult for us to think of social robots as mere tools (Duffy 2003; Proudfoot 2011; Calo 2015; Darling 2015). According to Calo (2015: 119), 'the effect is so systematic that a team of prominent psychologists and engineers has argued for a new ontological category for robots somewhere between object and agent'. Placing the social robot in an ontological category of its own would challenge a legal system that has, to date, tended to treat objects (robots included) as mere tools (Calo 2015; Richards and Smart 2015). Human psychology, therefore, threatens to 'upset [the individual-tool] dichotomy and the [legal] doctrines it underpins' (Calo 2015: 133).

Metaphors can also be used as deliberate framing devices, where the intent is to nudge a person to think of a robot in a particular way when interacting with it. For example, it might be beneficial to promote a strong tool metaphor when deploying mine clearing military robots, in order to prevent soldiers from becoming attached to those robots. Soldiers who have developed personal attachments to their robots have been known to risk their lives to 'save' the robots when those robots take damage and become 'injured' (Darling 2015). On the other hand, it might be beneficial to promote metaphors that encourage social bonding and trust in applications that rely on those social features for their success, in companion robots, for example (Darling 2015). The benefits of framing social robots as 'companions' extend beyond mere ease of use. As Darling notes, social robots are being designed to 'provide companionship, teaching, therapy, or motivation that has been shown to work most effectively when [the robots] are perceived as social agents' rather than mere tools (Darling 2015: 6).

Though some believe we err any time we commit the android fallacy, our choice of metaphor is decidedly flexible. Rather than limit our choice of metaphor based on narrow technical considerations, our decision to use a particular metaphor should depend on the particular robot being described, as well as normative
p. 603 outcomes and goals we wish to realize by using that robot. Importantly, there may be many ↳ societal benefits stemming from robotics that we stand to gain or lose depending on the metaphors we attach to each robot.

Policy and regulation are influenced by our choice of adopted metaphor for any particular robot. For example, one might be tempted to regulate driverless cars, such as the Google Car, much like any other car. However, in addition to requiring traditional technical solutions that will keep it safely on the road (for example an engine, steering and braking systems), driverless cars will also require software that automates complex ethical decision-making in order to navigate traffic as safely as possible (Lin 2013, 2014a, Lin 2014b; Millar 2015). As the following hypothetical scenario illustrates, this latter requirement could introduce new kinds of design and engineering challenges, which will in turn demand something novel from policy and regulatory bodies:

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> The Tunnel Problem: Steve is travelling along a single-lane mountain road in a self-driving car that is fast approaching a narrow tunnel. Just before entering the tunnel a child errantly runs into the road and trips in the centre of the lane, effectively blocking the entrance to the tunnel. The car is unable to brake in time to avoid a crash. It has but two options: hit and kill the child, or swerve into the wall on either side of the tunnel, thus killing Steve. If the decision must be made in milliseconds, the computer will have to make the call. What should the car do?
>
> (Millar 2015)

The tunnel problem is not a traditional design or engineering problem. From an ethical perspective, there is no 'right' answer to the question it raises. Thus, though a solution requires technical elements (e.g. software, hardware), the tunnel problem is not a 'technical' problem in any traditional sense of the term. In addition, the question clearly has ethically significant implications for Steve. Is there a metaphor that is useful for helping us to frame the ethical, design, and governance issues packed into the tunnel problem? Because the car will ultimately have to be programmed to 'make' the life-or-death decision to swerve this way or that we can think of it as a 'moral proxy', poised to make that important decision on Steve's behalf (Millar 2014, 2015). Completing the metaphor, as is the case in medical ethics where we have a long history of governing proxy decision-making, it could be that governing driverless cars effectively requires us to ensure the robot proxy (driverless car) is designed in such a way that it acts in Steve's best interests (Millar 2015). This could mean designing cars to have 'ethics settings' for their users, or it could mean bolstering informed consent practices surrounding driverless cars, say through broadly publicized industry standards surrounding automated ethical decision-making (Millar 2015). Borrowing from Darling's argument, the moral proxy metaphor can preserve individual autonomy over deeply personal moral decisions. Such a policy decision would undoubtedly complicate current legal and regulatory frameworks, and could be seen by manufacturers as undesirable (Lin 2014b). Given that automakers undoubtedly will be required to design for tunnel-like scenarios, regulatory agencies will be required to take such programming into account in
p. 604 their positions on driverless cars. Doing so will require both automakers and regulators to adopt novel ↳ metaphors like 'moral proxy', among others, to describe the various sociotechnical aspects of driverless cars.

Various other metaphors have been proposed for different novel robotics applications, each of which carries with it unique legal, policy and ethical implications. IBM Watson, the supercomputer that beat the two best human competitors at Jeopardy!, has been described as an 'expert robot' (Millar and Kerr 2016). IBM Watson is designed to extract meaningful and useful information from natural language (unstructured text-based sources), and can be trained to answer detailed and nuanced questions relating to a particular field. If trained well, Watson could perform better at particular tasks than its human counterparts, at which point it could make sense to describe it as an expert. Watson is currently being employed in healthcare settings, to help provide the bases for diagnoses, decisions about treatment plans, and other medical decisions (Millar and Kerr 2016). Watson works by scouring academic healthcare journals, patient records, and other text-based sources to 'learn' as much as it can about particular medical specialties. Watson is doing more and more of a job that has traditionally been done by human healthcare experts. Adopting the expert metaphor in the case of Watson could someday fit, but carries significant ethical and legal implications for other (human) healthcare experts, whose decision-making authority will be challenged in light of Watson's abilities. The expert metaphor will also challenge healthcare policymakers who will need to figure out the role that Watson should play within healthcare, and develop appropriate policy to govern it (Millar and Kerr 2016).

Robots have also been described as 'children', 'animals', and 'slaves' in various other contexts. Indeed, the growing number of metaphors used to describe robots indicates that there is no single metaphor that captures the essence of a robot or any other technology. Each choice of metaphor maps onto a particular set of values and perspectives, and each carries with it a unique set of legal, policy and ethical implications.

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Determining which metaphor to adopt in relation to a particular robot is an important decision that deserves growing attention if we are to interpret technology in a way that allows us to realize our normative goals for that technology.

3. Innovation and the Life Cycle of Sociotechnological Metaphors

Technology evolves with the addition of new features, capabilities, applications and uses. Likewise, the metaphors used to describe it will often require adjustment, or wholesale change in response to a new sociotechnical reality. Thus, metaphors, like ↳ the technologies they describe, have a life cycle of their own. Understanding this life cycle allows us to develop strategies for anticipating the effect that metaphors will have on a technology so that we can shape the technology and governance frameworks to satisfy our normative goals. As we will explain, though, controlling technological metaphors to achieve particular goals is no easy task.

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Science and technology innovations begin with metaphors that compare the old and familiar to the new and unfamiliar. For instance, Benjamin Franklin's electrical experiments were driven by observed similarities with lightning (Heilbron 1979). Alexander Graham Bell studied the bones in the human ear to craft the telephone (Carlson and Gorman 1992). The computer–mind metaphor has played an important and controversial role in directing artificial intelligence research and deployment (West and Travis 1991; Warwick 2011). Albert Einstein called his own creative, discovery process 'combinatory play' (Einstein 1954: 32). Innovation is, in essence, analogical reasoning:

> [T]he process whereby a network of known relations is playfully combined with a network of postulated or newly discovered relations so that the former informs the latter. Analogical thinking makes unmapped terrain a little less wild by comparing it to what has already been tamed.
>
> (Geary 2011: 170)

An integral part of the innovation process, metaphors may take a different shape during the design and distribution process, when they emerge from designing with the user in mind. A central question asked by human–computer interaction (HCI) researchers concerned with designing usable systems is, 'how can we ensure that users acquire an appropriate mental model of a system?' (Booth 2015: 75). Popular HCI textbooks explain that 'very few will debate the value of a good metaphor for increasing the initial familiarity between user and computer application' (Dix and others 1998: 149). The success of initial user interface metaphors like 'windows', 'menu', 'scroll', 'file', and 'desktop' continues to drive design paradigms, but not without controversy. Overt metaphors built into infamous user interface failures like General Magic's 'Magic Cap' in 1994 and Microsoft's 'Bob' in 1995 (both of which employed a 'home office' metaphor complete with images of desks, phones, rolodexes, and other office equipment), made some question the utility of metaphors in design and validated criticism by those that had felt the utility of metaphors in design had been overstated (Blackwell 2006). Conceptual metaphors help users understand the functionality and capabilities of a new system in relation to what they already understand, but users do not necessarily or instantaneously latch onto all conceptual metaphors, which then can create a clunky or confusing user experience. The user-focused interactive sense-making process continues to be endorsed and studied by HCI researchers and designers (Blackwell 2006).

Various human–robotic interaction (HRI) studies have demonstrated the usefulness and potential complications of using metaphors in design. Avateering and puppeteering metaphors have been shown to help users understand and operate ↳ telerobots (Hoffman, Kubat, and Breazeal 2008; Koh 2014). While the joystick metaphor is incredibly intuitive for humans directly controlling robot motion, it is problematic when the robot under control can also initiate movements. In these cases, 'back seat driving' or 'walking a

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dog' metaphors have been shown to improve task performance (Bruemmer, Gertman, and Nielsen 2007). Employing anthropomorphism in robot design is more controversial than joysticks or puppets because it brings to the forefront debates about utility versus design and social anxieties ranging from slavery to job loss (Schneiderman 1989; Duffy 2003; Fink 2012) but, as discussed previously, carries a degree of inevitability (Krementsov and Todes 1991; Duffy 2003; Fink 2012). Even unmotivated, people have a strong tendency to anthropomorphize artificial intelligence and robotic systems in ways that can lead to unpredictability, vagueness, and strong attitudinal and behavioural responses (Duffy 2003).

There are limits and consequences in attempting to direct users' perspectives. As expressed above, metaphors in computational design often take on a 'technology as tool' perspective, seeking to solve problems by framing them in very particular ways (Bijker 1987; Oudshoorn and Pinch 2005). Choices in design thus politically shape use, users and social outcomes surrounding a technology in particular ways (Winner 1980; Nissenbaum 2001). Robotics research, however, has started to use metaphors like 'swarms' (e.g. Brambilla et al. 2013) and 'teams' (e.g. Breazeal 2004; Steinfeld and others 2006) to develop and deploy technologies, suggesting an approach more closely aligned with Bruno Latour's actor–network theory (Latour 2005; Jones 2015), which recognizes the autonomy of technological objects, and politicizing design in ways that further acknowledge the powerful role of the technology in relation to human interactors.

Sooner or later technologies, if broadly adopted, are formally contested in regulatory or judicial settings, where competing metaphors play a central role. Technologies may even be designed to anticipate such formal contestations, bringing policy and law into the interpretive fold early in the innovation process. For instance, changes to media distribution in the 1990s through the 2000s saw significant metaphorical battles that altered the design of systems. The copyright industry lobbied both policymakers and the general public in an attempt to frame the debate, emphasizing that media copyrights are 'property' and insisting that unlicensed use of such material is a form of 'theft' and 'piracy'. Scholars and activists combatted this narrative with environmental metaphors like the 'digital commons', 'media recycling', and 'cultural conservation' (Reyman 2010: 75), as well as 'sharing' and 'gift' economies and cultures (Lessig 2008). Anticipating the effects of metaphors in the legal context might then begin to shape the outcomes of policy debates before they erupt, or perhaps avoid them altogether.

Metaphors also impact the way contested technologies are framed in political arenas. Controlling metaphors means controlling the conversation, and eventually the outcome. For this reason, political
p. 607 debates often become a battle of metaphors. ↳ In the early days of the Internet, numerous and varied sources argued about which metaphors should guide policy. Casting the Internet as an 'information superhighway', for example, suggests it is both a public resource and commercial interest. The information superhighway metaphor was used extensively in the 1992 American presidential campaign. Al Gore, an outspoken advocate for Internet development when it was still mysterious to the public explained,

> One helpful way is to think of the national Information Infrastructure as a network of highways—much like the interstates begun in the '50s … These highways will be wider than today's technology permits … because new uses of video and voice and computers will consist of even more information moving at even faster speeds … They need wide roads.
>
> (Gore 1993)

Casting the Internet as a separate 'cyberspace' suggests a borderless virtual community beyond the reach of national law. Activist and founder of the Electronic Frontier Foundation, John Perry Barlow, wrote in 1993

> Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. You are not welcome among us. You have no sovereignty where we gather.

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> (Barlow 1996)

Probing into other technological metaphors has been performed in numerous areas of technology law. Josephine Wolff (2014) analyses the three most common metaphors in cybersecurity—'burglary', 'war', and 'health'—to find their weaknesses. The burglary metaphor derives from concepts of physical security like fences and gates, but suggests that security flaws will be observable to defenders, making it possible to guard against all possible entry (Wolff 2014). Both the war and burglary metaphors situate as the threat human actors with agency and malintent, but the health metaphor likens threats to a pervasive disease that replicates indiscriminately (Wolf 2014). Similarly, some find weakness in lack of human involvement in cloud computing, which relies on other natural metaphors like 'data streams' and 'data flows' in which 'people are nowhere to be found' (Hwang and Levy 2015). Pierre de Vries (2008) challenges the spectrum-as-territory metaphor, arguing that non-spatial metaphors like 'the internet', 'internet protocol addresses', 'domain names', or 'trademarks' may be better suited to frame spectrum policy. The territory metaphor treats spectrum as a natural resource, implying a variety of other concepts like 'abundance', 'scarcity', 'utility', and 'productivity', which causes serious impediments to addressing signal interference problems (de Vries 2008). Instead, de Vries argues that 'trademarks' provides the most suitable metaphor, because rights and protections are achieved by registering with a government office and harmful interference can effectively be equated to unauthorized use of a mark (Vries 2008). These metaphors shape and control the political narrative and drive not only specific types of policies and outcomes but also provide creative and flexible solutions to governance issues.

p. 608 Before and after laws and policies are put in place, much of governance is further developed and refined through the court systems, where analogical reasoning is employed to determine how a new set of facts relates to facts in existing case law. Analogical reasoning by judges involves conforming their decisions to the existing body of law by surveying past decisions, identifying the way in which these decisions are similar to, or different to, the question at hand, and deciding the present, unsettled issue through this comparative exercise (Sherwin 1999). Cass Sunstein (1993: 745) describes this analogical work in the following four steps:

(1) Some fact pattern A has a certain characteristic X, or characteristics X, Y, and Z;

(2) Fact pattern B differs from A in some respects but shares characteristics X, or characteristics X, Y, and Z;

(3) The law treats A in a certain way;

(4) Because B shares certain characteristics with A, the law should treat B the same way.

Sunstein has defended this practice by arguing that judges who disagree on politics and theory may be able to find agreement on low-level analogies among cases allowing them to settle pressing questions without taking on controversial political or moral questions (Sunstein 1996).

Once settled on an area of law, such as contracts or criminal law, judges may exercise a narrow or broad form of analogical reasoning tying new technology to technology featured in past case law. Luke Milligan (2011) argues that judges deciding Fourth Amendment cases have focused too narrowly on the technical equivalents in prior cases, for instance, treating cell phones like pagers, address books, or simply as general containers. These cases rely heavily on the shared functions of the technologies, and Milligan proposes adding two broader aspects to this narrow analogical reasoning in Fourth Amendment cases: (1) the efficiencies gained by using a particular technological form of surveillance and (2) the ability to aggregate information based on surveillance technology employed (Milligan 2011). While technology designers may respond by designing according to or around judicial analogies that sort technology into categories of illegal or legal, liable or immune, legislators may also step in and pass laws when analogical reasoning leads to

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disfavoured outcomes. In the early days of the Internet, courts were asked whether online content providers (websites) were like publishers, distributors, or common carriers, all laden with different legal obligations (Johnson and Marks 1993). Two New York court cases dealt with this issue, one finding no liability for site operators whose sites contained defamatory material (*Cubby Inc v CompuServe Inc* 1991), and another holding the operator liable because it actively policed content for 'offensiveness and "bad taste" ' (*Stratton Oakmont Inc v Prodigy Servs Co* 1995). Congress then passed Section 230 of the Communications Decency Act
p. 609 to ensure that site operators would not be held liable for content produced by third parties even when ↳ posts were curated (Communications Decency Act 1996), putting an end to questions of whether websites were publishers, distributors, or common carriers for the purposes of information-related legal claims by prohibiting them as being treated as anything but immune intermediaries.

Today debates rage over the legal relevance of the sociotechnical differences between pen registers and metadata (*ACLU v Clapper* 2013: 742; *Klayman v Obama* 2013), beepers and GPS (*US v Jones* 2012), remotely controlled military aircrafts and autonomous drones (United Nations Meeting on Lethal Autonomous Weapons Systems 2015), and the virtual and physical realms (Federal Trade Commission 2015). Technologies that have reached this stage come with an extraordinary amount of conceptual baggage that too often is neglected. It is true that early developments in innovation conceptualization and design impact political and legal metaphors that emerge as the technology matures. Therefore, we would be wise to start addressing the important and influential issue of metaphors earlier in the technological life cycle to gain what we can. The life cycle of a technological metaphor involves comparative and combinatory sense-making at the initial stages of innovation, adjustments made for and by the use and user of the technology, political framing by regulators, and analogical reasoning in the courts. Analytical tools for assessing and crafting technological metaphors to bring about particular governance goals over the course of this life cycle remain an important and underdeveloped aspect of both the anticipatory governance and law and technology fields.

4. Hacking Metaphors in Anticipatory Governance

Computer scientists and legal scholars agree that searching for the 'best' or 'right' metaphor when confronted with new technology is often time poorly spent. 'Searching for that magic metaphor is one of the biggest mistakes you can make in user interface design' (Cooper 1995: 53). As an example, legal scholars Johnson and Marks (1993) argue that such pursuits did not take advantage of, and even ignored, the malleability of the Internet in its early years. Attempts to 'fit' cyberspace to existing legal metaphors at the time threatened to 'shackle' the new medium, thus preventing cyberspace from developing in ways that best suited both designers and users (Johnson and Marks 1993: 29).

A more fruitful task, then, is to find the metaphor that helps to accomplish a particular set of normative goals. Philosopher and design scholar Donald Schön (1993) explains that metaphors can have conservative
p. 610 or radical impacts. Metaphors can ↳ be used as flexible 'projective models' that realize the uniqueness, uncertainty, and ambiguity of something new. Or, a metaphor can serve as a defensive mechanism wherein describing idea A in terms of idea B limits the nature of B: A's essence remains unexamined and its limits are imparted onto idea B (Schön 1993).

Anticipatory governance at both the early stages in robotics design and in late stage court cases should involve projective models that highlight the radical function of robot metaphors in shaping our sociotechnical reality. Importantly, ethicists, policymakers, regulators, lawyers, and judges should recognize that every metaphor is a choice rather than a discovery, and that the choice of one metaphor over another necessarily preferences a very particular set of values over others. Choosing metaphors is an important task with powerful implications and, as such, the process should be thoughtful and open. In

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governance contexts, ‘we should apply the available metaphors in light of overarching goals and principles of justice, while also keeping in mind the implications of selecting any given metaphor’ (Schön 1993: 11).

We suggest something closer to structured play for developing and reflecting upon metaphors in the anticipatory governance of robotics and other technologies. This structured play, which we refer to as metaphor hacking, makes transparent the various links between metaphors, technology, and society. Metaphor hacking, as we propose it, is a process that involves five deliberate steps:

1. Acknowledge the initial (subjective) sense-making metaphor;
2. Challenge the singular sense-making metaphor by testing other metaphors;
3. Work through potential outcomes of competing metaphors;
4. Assess outcomes based on normative goals;
5. List limitations of achieving metaphor victory

4.1 An Example of Metaphor Hacking: Driverless Cars

Driverless cars are a coming technology, and have been widely sensationalized in the media as solutions to all of our automotive woes. However, they pose significant governance challenges ranging from questions regarding liability (of manufacturers, programmers, owners/operators, and even the cars themselves) to ethical questions regarding the social implications of the technology.

The tunnel problem, outlined above, is a good example for framing some such challenges, one that can be used to demonstrate the benefits of metaphor hacking. It is representative of a class of design problems that involve value trade-offs between passengers, pedestrians, and other drivers/passengers (Millar 2015). Other problems, involving similar value trade-offs have been discussed elsewhere (Lin 2013) that could benefit from an examination of the tunnel problem.

p. 611 In this example, we demonstrate how two competing metaphors—the ‘chauffeur’, and the ‘moral proxy’—lead to quite different analytical outcomes when ‘tested’ using our framework. As described above, the moral proxy metaphor is motivated by a desire to preserve individual autonomy over decision-making in deeply personal ethical dilemmas. The chauffeur metaphor, on the other hand, is likely the metaphor that many people would think of as a default for the technology: it captures the role that a driverless car appears to play in the use context, insofar as the car is metaphorically driving you around while you comfortably sit back and wait to arrive at your destination. Thus, for the purpose of this example we treat the chauffeur metaphor as the ‘initial (subjective) sense-making metaphor’, while the proxy metaphor serves as a challenger.

We acknowledge up front that a fuller analysis is possible, which would result in much more detail at each stage of the process. We also acknowledge that the tunnel problem is but one of a number of governance triggers (i.e. scenarios that suggest the need for new/modified governance responses) pertaining to driverless cars that could benefit from metaphor hacking. However, due to space limitations, we provide here a sketch of a fuller undertaking in order to demonstrate the analytical benefits of metaphor hacking.

4.1.1 Acknowledge the initial (subjective) sense-making metaphor

The initial step involves recognizing one’s own sense-making of the technology. Where do you imagine you would sit in the car? Do you speak to the car politely or give short commands? How often do you check to make sure things are running smoothly?

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4.1.1.1 Metaphor: ‘chauffeur’

Description:

Driverless cars are most often envisioned transforming the driver into a passenger. In other words, the driver is pictured doing no driving at all. Google’s most recent driverless car prototype, featured in a much-hyped online video, has no steering wheel, leading one passenger featured in the video to remark ‘you sit, relax, you don’t have to do nothing [*sic*]’ (Google 2014). With this picture in mind, it is reasonable to characterize the car as a robot chauffeur, driving the car from place to place as you catch up on your email, phone calls, or take a much-needed nap.

4.1.2 Challenge the singular sense-making metaphor by testing other metaphors

There are many ways of conceptualizing driverless cars. We might opt to consider them like any other car, but with increasingly more technological functions. After all, other features, including brakes and transmission, have been automated without much need for reconceptualization. A useful conceptual move
p. 612 to capture the ↳ redistribution of autonomy between driver and vehicle might be to readopt the ‘horse’ metaphor. Driverless cars could also be compared to transformations in public transportation, wherein everyday travel is reorganized in a networked fashion and leaves the traveller with little control over the actual act of driving.

Though these (and many other) metaphors should all be examined for their governance implications, we will focus mainly on the chauffeur and moral proxy metaphors for the sake of brevity.

4.1.2.1 Metaphor: ‘moral proxy’

Description:

In a class of cases where driverless cars, and their passengers, encounter critical life-threatening situations like the tunnel problem, the car must be programmed, or ‘set’, to respond in some predetermined way to the situation. Such ‘unavoidable crash scenarios’ are reasonably foreseeable and will often result in injury and even death (Lin 2013, 2014a, 2014b; Goodall 2014; Millar 2014, 2015). These scenarios often involve value trade-offs that are highly subjective and have no clear ethically ‘correct’ answer that can be unproblematically implemented. Given that the car must be programmed to make a particular decision in unavoidable crash scenarios, either by the engineers while designing it, or through the owner’s ‘settings’ while using it, the car can reasonably be seen as a moral proxy decision-maker (Millar 2015).

The narrowest way to conceptualize a driverless car is just to treat it as any old car with more technological features: this approach would require the least change to existing governance frameworks. Conceptualizing a driverless car as a chauffeur is still fairly narrow in scope, but focuses attention on changes to the control of the act of driving. Similarly, comparing driverless cars to horses involves a relatively narrow focus on the autonomy of the transportation apparatus. The moral proxy metaphor is more expansive and includes more social functions involved in driving. Thinking about driverless cars as a transformative form of public transportation is the broadest and opens up numerous lines of inquiry. Other metaphors could emerge if focusing on adding a new technology to the roadways or when considering the ways in which people now rely on connected services to manoeuver through public spaces, each metaphor being slightly different in scope.

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4.1.3 Work through potential outcomes of competing metaphors

4.1.3.1 Chauffeur

In most ordinary driving contexts, the chauffeur metaphor will capture the kinds of functions that driverless cars exhibit. If manufacturers are able to deliver on their promises, driverless cars will generally drive passengers around without incident.

Treating a driverless car as a chauffeur when things go wrong, however, could result in some of the worries raised by Richards and Smart (2015). Though driverless cars will appear as if they are driving you around, we
p. 613 would be committing the ↳ android fallacy in thinking of them as 'agents' in any moral or legal sense, especially if attempting to dole out legal/ethical responsibility. Driverless cars are not moral agents in the same sense as a human chauffeur who, like any responsible human adult, is capable of making fully rational decisions. Thus, in contexts where we need to decide how to attribute liability based on models of responsibility, the chauffeur metaphor will likely cause problems.

4.1.3.2 Moral Proxy

In a very particular subset of situations—those involving tunnel-like value trade-offs—the moral proxy metaphor could help sort out issues of responsibility. The moral proxy metaphor underscores the inherently political and ethical nature of technology design (Winner 1980; Latour 1992; Verbeek 2011; Millar 2015) and invites designers, users, and policymakers to focus on *who* should be programming/setting a driverless car to operate in a specific mode, as well as focusing on robust informed consent requirements in making those programming/settings choices explicit (Millar 2015). In doing so, the moral proxy metaphor, as a governance tool, places higher requirements on all parties involved to clearly assign responsibility in advance of using the technology, but treats those requirements as beneficial owing to the gains in clarity of responsibility. This approach has been challenged on grounds that it complicates the law (Lin 2014b), but at least one study indicates that there might be support for a more robust informed consent in the governance of certain driverless car features (Open Roboethics Initiative 2014).

4.1.4 Assess outcomes based on normative goals

At this point, one can ask: what are the normative goals? By placing the normative question late in the process, we can see the sense-making that occurs based on the design and use of the technology, as opposed to considering only ways to think about the technology to solve a particular policy problem. This can help avoid disruption to the policy process when those metaphors are not usefully understood by the broader public, different populations of users, or in later policy decisions and keep the process agile and dynamic.

4.1.4.1 Normative goals

Clearer models of responsibility for dealing with liability and users' (moral) autonomy, and information practices that respect the privacy of users in the context of driving.

4.1.4.2 Chauffeur

Although the chauffeur metaphor may cause problems by attributing a level of autonomy to the car itself, it may be beneficial to shifting responsibility onto the car designers, if that becomes the direction policymakers want to go. However, the normative goal stated is *clearer models* of responsibility. Therefore,
p. 614 the chauffeur ↳ metaphor's departure from existing accountability models is less satisfactory than the moral proxy model.

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The chauffeur metaphor may be valuable to meeting privacy goals. If users of driverless cars consider the car to be as aware and attentive as another person in the car, they may regulate their behaviour in a way that aligns with their information sharing preferences. The metaphor may fall short, though, because the driverless car may actually gather and process more or different information than another person in the car would gather and process (see, for example, Calo 2012).

4.1.4.3 Moral proxy

The moral proxy is intended to clearly delineate responsibility, but may not meet that goal depending on how users of driverless cars understand the model and perhaps misunderstand their roles while in the vehicle. The moral proxy may serve the goal of protecting privacy if standards of information are incorporated as part of the design and users are informed about the limited information gathering practices undertaken. However, the metaphor could also complicate the goal of privacy. How much information does a moral proxy need to make moral decisions? This uncertainty may lead users to overshare information and policymakers to accept such practices as necessary for moral functioning.

By playing with the outcomes in light of the normative goals, it becomes clearer what type of situated use information or testing is still necessary. This step may also raise particular issues with the normative goals themselves and reveal that the goal is still quite unclear or contested.

4.1.5 List limitations of achieving metaphor victory

4.1.5.1 Chauffeur

The chauffeur metaphor is likely the easier of the two metaphors to understand and adopt because it is natural for people to commit the android fallacy (Darling 2015) and driverless cars fit the metaphor in most normal driving contexts. This may be truer in urban areas where travellers are regularly driven by other people and more successful in the judicial arena where analogical reasoning is somewhat restrictive.

4.1.5.2 Moral proxy

This metaphor could be more difficult for people to understand/adopt because it requires understanding the legal/ethical technicalities of responsibility and liability. It also requires policymakers, lawyers, judges, ethicists, and users to understand, to some degree, the complexity of the programming challenge involved in making driverless cars.

The other metaphors suggested have significant limitations. For instance, conceptualizing a driverless car as a horse does not account for the information available about how a driverless car operated and made certain choices in liability litigation. Additionally, how useful is a horse metaphor when few people today
p. 615 have ever seen ↳ a horse used for transportation, let alone experienced it? These are strong reasons to discard the horse metaphor.

Based on this rough analysis, we may decide that the moral proxy metaphor is more beneficial and encourage designers, marketers, and users to incorporate it. We may also decide that we need more information and that these metaphors need to be tested for actually usability and expected outcomes. It may be most important to know which metaphors should be avoided and to have thought through the many ways that others can make sense of robots.

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5. Conclusions

Metaphors can both describe and shape technology. In governance contexts, metaphors can be used to frame technology in ways that attach to very specific, often competing, sets of values and norms. Thus, competing metaphors are not just different ways of thinking about a technology; each metaphor carries different ethical and political, that is, normative, consequences. We have proposed metaphor hacking as a methodology for deliberately considering the normative consequences of metaphors, both in design and governance.

Although design choices and framing are powerful tools, our ability to control the way people make sense of technology will always be limited. Ultimately people will interpret technology in ways that thwart even the most rigorous attempts at shaping technology and the social meaning applied to it. The considerations we have raised and our proposed methodology for metaphor hacking help to guide what control and influence we do have in a way that legitimizes those efforts. In the humblest cases, we hope a more deliberate process will ease necessary ethical, legal, and regulatory responses, thus smoothing our technological future. More importantly, our hope is that metaphor hacking will help with the complex task of technology governance, by laying bare the fact that good design requires us to anticipate people's responses to switches, knobs, and metaphors.

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