Neuroscience, Artificial Intelligence, CRISPR — and Dogs and Cats

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INTRODUCTION

In some jurisdictions, dog owners are responsible for damage done by their trespassing pets, while cat owners are not. Why? And what, if anything, might that have to do with humans, neuroscience, robots, artificial intelligence, or the revolutionary DNA editing technique known as clustered regularly interspaced short palindromic repeats ("CRISPR")?

This essay is the start of an attempt to tackle those questions. It looks for common elements behind the accountability of (or for)

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entities[1] controlled, in whole or in part, by brains, artificial intelligence, or genetic modifications. (I use the term "accountability" rather than "responsibility" or "liability" because I do not want to limit the concept to liability for damages or responsibility in the criminal justice system, which those words might imply to legal readers. I want a term that, although including those, extends more broadly to a sense of moral accountability.) The thought that teases me is that the controllability and predictability of such an entity might be inversely related to the entity's "own" accountability, but directly related to the accountability of its "creator," modified, perhaps, by considerations of the danger the entity poses.

I am using "predictability" and "controllability" here as importantly related to "autonomy" or "agency."[2] The general idea is that an entity whose behavior is completely *predictable* should not be individually accountable for damage it does. Rather, that accountability should rest with its "creator" (if any). Similarly, an entity whose behavior is completely *controllable* should have no individual accountability but that should also rest with its "controller," if it has one.

At the other extreme, an entity whose behavior is, to a substantial extent, imperfectly predictable or controllable is accountable in its own right, although that may not entirely absolve its creator or controller from accountability. And finally, there is a special case: an entity whose behavior is neither predictable nor, in a specific case, controllable because its behavior is set to be random. I am not sure where accountability lies in that situation, but considering it may (or may not) help illustrate the other situations.

This approach, at most, backs into the vexed question of free will. It does not ask whether an entity *has* free will, but looks for evidence (possibly conclusive) that the entity does *not* have free will.[3] The connection is through a negative inference: that in situations where an

[1] I use the term "entity" because the subjects of this essay are humans, machines, and a wide range of life forms (including dogs and cats).

[2] In the context of robots, Ryan Calo, in one of his seminal robot law articles, talks of "emergence": "The literature tends to refer to this exciting potential as 'autonomy' or 'true learning,' but I prefer 'emergence.' Emergence refers to unpredictably useful behavior and represents a kind of gold standard among many roboticists . . . ." Ryan Calo, *Robotics and the Lessons of Cyberlaw*, 103 CALIF. L. REV. 513, 532 (2015) (footnote omitted). I can see some attraction in the term, but I prefer to stick to words that are more likely to be immediately understood by my readers.

[3] The question of the very existence of "free will" makes my head hurt. I cannot understand how I can "have" it, but I cannot feel that I do not. Encouragingly, for me, it has similarly puzzled thinkers for millennia. For a primer, see THOMAS PINK, FREE WILL: A VERY SHORT INTRODUCTION (2004).

entity's behavior is either totally predictable or totally controllable, it cannot be said to have free will. This will rarely, but occasionally, be relevant to humans, who are almost never fully predictable or controllable, but it may help when we think of artificial intelligence or genomically modified organisms.

But I now must set out exactly what, in this essay, I intend these inferences to mean. I do *not* believe that "free will" is necessary, legally or morally, for accountability; neither do I believe that the inferred absence of free will makes accountability either legally or morally impossible. I do believe that many strains of "our" culture (leaving open the vexed question of "our") hold those beliefs.

This is, therefore, not a paper making a normative suggestion for policy changes based on underlying moral framework. Neither is it a paper suggesting policy changes because they will have good consequences; it does not really begin to explore the actual effects, positive or negative, of adopting such a system of accountability. Instead, the paper is, in some respects, a prediction about how "Americans" or American legal culture will want to react with regard to accountability in the three contexts it discusses — or, perhaps, how it logically *should* react in light of what I believe to be its underlying beliefs.

I am genuinely uncertain about this effort. I do not have the background, either in philosophy or in the most relevant areas of the law,[4] to be confident that my thoughts have not been tried and found wanting before. Nonetheless, I will proceed, in the hope that these thoughts may be useful to others struggling with these questions. And, perhaps, because I can do no other.[5]

This essay has five parts. The second, third, and fourth will discuss these issues in three specific contexts: humans (first adults and then

[4] I know very little about artificial intelligence and robots or the law thereof. I have not taught either Criminal Law or Torts, which seem to me particularly home to issues of responsibility in the law. Neither have I taught employment law nor agency, another possibly relevant course, except in passing (but then, no law professor has taught agency as a separate course in the last forty years). I do teach Property and Contracts, as well as health law and a variety of courses and seminars involving the law and the biosciences, which, no doubt, explains some of what follows.

[5] See the statement attributed to Martin Luther at the Diet of Worms in response to urgings that he recant: "I cannot and I will not recant anything, for to go against conscience is neither right nor safe. Here I stand, I cannot do otherwise, God help me. Amen." It is now widely questioned whether Luther actually said the last sentence, but the tradition goes back to the earliest printed versions of his statement. *See* Scott A. Hendrix, *Legends About Luther*, CHRISTIAN HIST., 1992, https://www.christianhistoryinstitute.org/magazine/article/legends-about-luther/. Luther was substantially more confident of his position than I am of mine (except as an ironic statement about free will).

children) in the light of neuroscience, robots in light of artificial intelligence, and then genomically modified organisms in light of CRISPR. The second part is substantially longer than the third or fourth as it sets up many of the concepts applied in those. The last part will add a few concluding thoughts.

But, to go to the first part, let's talk about pets.

I. DOGS AND CATS

In more than three decades of teaching the law of trespass in the first-year Property course, I have discussed people's liability for the trespasses of their instrumentalities, whether crashing cars, errant Frisbees, or roving cattle. And always I have noted that dog owners are generally liable for their trespassing dogs, while cat owners, at least in some jurisdictions, are not liable for their felines' trespasses. I have said that because a note in one Property casebook I saw said that, but I have never investigated further — it was a throw-away line, leading to a joke about how cats actually own their "masters." But, as I started thinking about this essay, I wondered if it really is true, and whether it might be relevant to my investigation.

After siccing my research assistant, James Rathmell, on the topic, I found out that, not surprisingly, it depends. The definitive (in the sense of "maybe the only") scholarly work on this topic is a 3½ page student comment by Edward M. Boyne in the first issue of the 1927–28 *Cornell Law Quarterly*.[6] According to the comment, English common law had generally imposed strict liability on the owners of (captured) wild animals (ferae naturae) for their trespasses. The same rule applied to owners of domestic animals, although this was often modified in the United States by "fence out" or open range rules.

Owners had not, however, been held liable for trespassing dogs. American jurisdictions quickly passed statutes changing that rule, at least with respect to trespassing dogs that had injured cattle. The comment was built around a 1926 English case, where the appellate court held that a cat's owner was not liable for its trespasses among a neighbor's (soon decimated) prize pigeons, absent "some vicious propensity of the particular cat which was known to the owner . . . ."[7]

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[6] *See* Comment, *Torts: Trespass: Liability for Damage by Trespassing Cat*, 13 CORNELL L. Q. 150, 151-52 (1927-28).

[7] Buckle v. Holmes (1926) 2 KB 125. For additional evidence that legal authors even then enjoyed writing about the occasional humorous case, the Cornell Comment cites six different English publications noting the case. *See* Comment, *supra* note 6, at 151 & n.14. The Cornell author found only one other case with a similar holding, a lower court Pennsylvania case, of which he does not approve, protecting a cat owner

(The "vicious propensity" limitation follows from a general legal approach of giving every dog "one free bite" before its owner, who would then be on notice of the dog's disposition, is liable for its bites.)

The comment lists five reasons for the immunity of cats (and, in many cases, dogs): the difficulty of restraining them; the small damage they normally can do; the common custom of letting them roam freely; their unauthorized taking not counting as larceny (which it notes was overcome by statute); and their "natural kindness and docility," on which it casts some doubt. Boyne disliked this rule and predicted it would shortly be overcome, either by courts holding that owners *must* be held to know of the vicious habits of cats (at least toward birds) or by legislation similar to that making dog owners liable for harassing cattle.

In the United States that has not happened — at least, not clearly. The few subsequent cases have held owners free of responsibility for the depredations of their marauding cats. Meanwhile, owners are often liable for damage done by trespassing dogs, under either cattle-specific statutes or leash laws.[8] In a cat case, *Van Houten v. Pritchard*,[9] for example, the court stated

> the case at bar does not involve a large domestic animal which will invariably cause damage if allowed to roam at will, and neither does it involve the violation of a leash law. Instead, it involves a domestic animal that is not likely to do harm if allowed to run at large.[10]

from liability for a neighbor's killed canary on an analogy to rampaging rabbits or pigeons. McDonald v. Jodrey, 8 Pa. C. 142 (1890).

[8] The Restatement (Second) of Torts provides immunity from strict liability for both dogs and cats, as well as bees, pigeons, similar birds, and poultry, in Section 518(j), entitled "Animals Permitted to Run at Large," at least "in a locality in which by custom they are permitted to run at large." RESTATEMENT (SECOND) OF TORTS § 518 cmt. j (AM. LAW INST. 1977). The Restatement goes on to say, "While it is not impossible to confine dogs to the premises of their keepers or to keep them under leash when taken into a public place, they have been traditionally regarded as unlikely to do substantial harm if allowed to run at large, so that their keepers are not required to keep them under constant control. The same is true of cats." *Id.* Leash or cattle laws often change that outcome for dogs but not for cats. Verne R. Smith, *The Law and Feral Cats*, 3 J. ANIMAL L. & ETH. 7, 7 (2009) ("For example, every state has a comprehensive dog law, but only three states . . . have comprehensive statutes pertaining to cats.")

[9] Van Houten v. Pritchard, 315 Ark. 688, 689 (1994).

[10] *Id.* at 691. Justice Hays wrote a spirited dissent in which Chief Justice Holt joined. *Id.* at 693-95 (Hays, J., dissenting).

An owner who knows her cat is unusually vicious and prone to bite (presumably people) has special responsibilities; liability for damages caused by trespassing cats that are only usually vicious seems somewhere between unlikely and questionable.[11]

Apart from pure enjoyment, at least for lawyers, what is the point of this far from expert or exhaustive survey of some dog and cat trespass cases? Cats are special. People are generally liable for their marauding cattle and other livestock; they are quite strictly liable for damages perpetrated during the escape and trespass of dangerous wild animals they keep;[12] and they are liable in many circumstances, under special cattle protection statutes or leash laws, for harm done by their trespassing dogs . . . but they are not (usually) liable for their cats.

Unlike the comment writer in the *Cornell Law Review*, who had five reasons, I suggest that two main things are at play here. First, cats are inherently less controllable than dogs. Leashing or muzzling cats is implausible; fencing them in a yard or even keeping them from sneaking out of a house through open windows or doors can be very difficult. Second, cats are viewed as not likely to do substantial harm, at least in the absence of particularized evidence to the contrary. These general insights, with supplementation, may be useful in thinking about accountability in the contexts of human neuroscience, robots and artificial intelligence, and genetically modified organisms.

II. HUMANS AND NEUROSCIENCE

Neuroscience is vastly and rapidly increasing our understanding of human behavior. It raises fascinating (and frustrating) questions about accountability, especially in competent adults. But those questions will

[11] Jackson v. Mateus, 70 P.3d 78 (2003) (discussing cat liability extensively in upholding summary judgment against a neighbor bitten by the defendants' house cat). That court found it persuasive "that no other jurisdiction has recognized a duty on the part of a cat owner to restrain or muzzle a domestic cat that has demonstrated no previous propensity to cause harm" and follows the statement with an eleven-case string citation. *Id.* at 83.

One appellate case from Georgia said cats and dogs should be treated the same, but in the context of the plaintiff suing for being bitten. Fellers v. Carson, 182 Ga. App. 658, 658 (1987). The court affirmed summary judgment against someone bitten by a trespassing cat on the "one bite" rule, stating, "There is no authority for appellee's assertion that cat bite cases should be treated differently than dog bite cases." *Id.* It appears the main legal reason they are often treated differently today stems from legislation: either leash laws or other dog-specific statutes or ordinances.

[12] See the famous English case, often used as the fount of "ultra-hazardous activity liability," Rylands v. Fletcher (1866) LR 1 Ex. 265, 279-80, *aff'd*, (1868) 3 LRE & I. App. 330 (HL) (appeal taken from Eng.).

also lead us to some considerations about the accountability of, and the accountability for, children. This part deals with both.

A. Adults

Philosophers, along with some neuroscientists, seem not to have enough free will to avoid fixating on free will, especially in the criminal justice system. Since the 2002 dawn of the modern era of neuroethics — the proximate result of the advance of functional magnetic resonance imaging ("fMRI") in humans[13] — most of the work in law and neuroscience has involved issues of criminal responsibility. This work started with ideas in early publications by both neuroscientist Robert Sapolsky and philosophers Jonathan Cohen and Joshua Greene that argued, in effect, that when neuroscience showed us that criminals had no free will in their criminal action, then criminal law would dry up and blow away.[14] Debate was then joined, with the other side marked by the stalwart opposition of Stephen Morse, a law professor and clinical psychologist at the University of Pennsylvania. Morse argued early and often that the law cares about rationality for criminal responsibility but not about free will.[15] Morse has largely won that battle among law professors, although neither unanimously[16] nor without some qualifications.[17] It is not clear whether he has won it with judges and attorneys, as shown by the

[13] Henry T. Greely, *Happy 15th Birthday, Neuroethics!*, NEUROETHICS BLOG (May 13, 2017), http://www.theneuroethicsblog.com/2017/05/happy-15th-birthday-neuroethics.html.

[14] *See* Joshua Greene & Jonathan Cohen, *For the Law, Neuroscience Changes Nothing and Everything*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B 1775, 1784 (2004); Robert M. Sapolsky, *The Frontal Cortex and the Criminal Justice System*, 359 PHIL. TRANSACTIONS ROYAL SOC'Y LONDON B 1787, 1793 (2004).

[15] Morse's publications on this point and its many variations have been legion, starting (I think) before the beginning of modern neuroethics, and widespread use and appreciation of functional magnetic resonance imaging, with Stephen J. Morse, *Brain and Blame*, 84 GEO. L. J. 527, 533 (1996). After 2002, his first contribution on the point was a chapter in a report by the American Association for the Advancement of Science and the Dana Foundation. Stephen J. Morse, *New Neuroscience, Old Problems*, *in* NEUROSCIENCE AND THE LAW: BRAIN, MIND, AND THE SCALES OF JUSTICE 157-98 (Brent Garland ed., 2004).

[16] *See* Adam J. Kolber, *Free Will as a Matter of Law*, *in* PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE (Dennis Patterson & Michael S. Pardo eds., 2016).

[17] *See* Deborah S. Denno, *The Place for Neuroscience in Criminal Law*, *in* PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE, *supra* note 16, at 69, 71-72; Nita A. Farahany, *A Neurological Foundation for Freedom*, *in* PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE, *supra* note 16, at 51, 53.

growing literature on the expanding use of neuroimaging in criminal trials.[18]

I declared a personal allergic reaction to the whole topic[19] and have long urged that far more attention should be placed on the legal implications of neuroscience used for prediction, mind-reading, treatment, and enhancement — and *much* less attention to responsibility. But I did succumb to the temptation to opine, and then write, on the topic once before. It was for a symposium at University College London,[20] which resulted in a chapter in a book on responsibility.[21] The chapter's subtitle, *Proving "Can't Help Himself" as a Narrow Bar to Criminal Liability*, gives away my conclusion. I argued, using examples like Tourette's syndrome, Brunner syndrome (the absence of a functioning MAO-A gene in males), frontotemporal dementia, and a most likely unique case of a "pedophile tumor," that the law somehow does, or should, excuse behavior when there is firm, particularized, medical or scientific evidence to believe that the person *could* not have acted otherwise. I further urged that such cases are very likely to remain rare.

With regard to humans, this essay divides the argument to specify that the excusing condition could be either perfect predictability or perfect controllability. Thus, the kinds of medical conditions discussed in the chapter could be viewed as either making the behavior perfectly predictable or resulting from the person being "perfectly" controlled by his or her disease.[22]

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[18] *See generally* Jennifer A. Chandler, *The Use of Neuroscientific Evidence in Canadian Criminal Proceedings*, 2 J.L. & BIOSCIENCES 550 (2015); Deborah W. Denno, *The Myth of the Double-Edged Sword: An Empirical Study of Neuroscience Evidence in Criminal Cases*, 56 B.C. L. REV. 493 (2015); Nita A. Farahany, *Incriminating Thoughts*, 64 STAN. L. REV. 351 (2012); Nita A. Farahany, *Neuroscience and Behavioral Genetics in US Criminal Law: An Empirical Analysis*, 2 J.L. & BIOSCIENCES 485 (2016); Michael J. Saks, *The Impact of Neuroimages in the Sentencing Phase of Capital Trials*, 11 J. EMPIRICAL LEGAL STUD. 105 (2014).

[19] "I have avoided that topic the way I might avoid a drunken and belligerent brother-in-law at a family reunion: by keeping a very careful distance." Henry T. Greely, *Neuroscience and Criminal Responsibility: Proving 'Can't Help Himself' as a Narrow Bar to Criminal Liability*, *in* LAW AND NEUROSCIENCE: CURRENT LEGAL ISSUES 2010, VOLUME 13, at 61 (Michael Freeman ed., 2011) [hereinafter *Neuroscience and Criminal Responsibility*].

[20] A cynic *might* suspect that a free trip to London overcame my allergic reaction and any related scruples.

[21] *See* Greely, *Neuroscience and Criminal Responsibility*, *supra* note 19, at 61-77.

[22] As the legal "excuse" follows from either, the choice may not matter. I think I prefer to consider it predictability, thus avoiding the problem of deciding when a person's disease is "part of" her or him.

Applying this approach to humans has, however, two problems. First, I can find very few examples of people whose behavior is either perfectly predictable or completely controlled. Second, in some of those few cases, legal and moral doctrines other than the one proposed in here could explain the results.

One can predict perfectly the relevant behavior of someone who is in a persistent vegetative state, in a coma, or (barring sleepwalking or another unusual occurrence) asleep. The predictability, or uncontrollability, of their "behavior" in such states might protect them from accountability for not taking some action, but it seems more straightforward to use their lack of consciousness as an excuse. Perhaps some profoundly mentally disturbed people, those who are catatonic or those with extremely severe intellectual disability, might have similarly predictable "non" behaviors, but, again, existing excuses based on their disabilities seem more direct. People in a locked-in state may be a little more useful for my purposes; those people can be perfectly conscious and without any mental disability but without any way of expressing themselves. Their inaction is thus perfectly predictable and not based on any mental limitation such as insanity or competency.

In a different way, one can predict that a living human will eventually take another breath. You cannot hold your breath forever; in fact, your body will not even let you hold your breath until you are unconscious (and then will presumably force you to start breathing again).[23] Similarly, everyone will eventually fall asleep. If, somehow, breathing or eventually falling asleep (or performing any other unavoidable bodily functions) were charged as a dereliction of some sort, presumably biology would be a defense — at least at some point. Determining exactly at what moment that person could no longer hold her breath or stay awake, however, might be difficult.

When we move to people without these kinds of disabilities or biological necessities, proof of predictability, and perhaps the very concept, becomes difficult. If you observed me for at least the last fifty years, you could say that shortly after awakening for each day, I

[23] A very, very few people have a medical condition that requires them to consciously force themselves to breath. This is called "congenital central hypoventilation syndrome," "primary alveolar hypoventilation," or, sometimes, "Ondine's curse." Ondine, a nymph, did not have this condition herself but cursed her unfaithful mortal husband with it. *See* Ravindra Nannapaneni et al., *Retracing "Ondine's Curse,"* 57 NEUROSURGERY 354 (2005); *Central Hypoventilation Syndrome, Congenital: #209880*, OMIM, https://www.omim.org/entry/209880 (last visited Mar. 25, 2018).

brushed my teeth (I think). You might thus predict that every future awakening, I would do the same. But does the fact that my tooth brushing behavior has been entirely predictable under the circumstances I encountered necessarily mean that if you changed the circumstances — specifically to a situation where, for some reason, I *shouldn't* brush my teeth — you could be certain of my behavior? And if my brushing my teeth did lead to some foreseeably bad result, would you excuse me from accountability for that result on the ground that my behavior was entirely predictable? If that were not the conclusion, and it seems to me that it probably should not be, then, perfect predictability may not have much bite in dealing with humans.[24]

I am using perfect predictability here as (very good) evidence for a lack of control. If you can predict perfectly a person's behavior, that behavior would seem to be something that the person cannot control by changing. But another way to infer that a person does not have control is to show that the person is completely controlled by another.

But perfect controllability is also hard to find in real humans. Outside the fictional "Imperius" curse from Harry Potter's world[25] or the delusions of mind control suffered by "targeted individuals,"[26] it is hard to find examples. I cannot think of one directly on point, though I can imagine some.

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[24] I can imagine the force of such a persistent habit being relevant to accountability, perhaps requiring that the toothbrusher have more than usual warning that, this time, his behavior was dangerous. But, because I "know," from my subjective experience, that I could change the behavior, to me it would not qualify for the excuse of "perfect predictability."

[25] The curse, one of the three so-called "unforgiveable curses," is first described by the seeming Professor Moody in chapter fourteen, "The Unforgivable Curses." J.K. ROWLING, HARRY POTTER AND THE GOBLET OF FIRE 212-17 (2000).

[26] "Targeted individuals" is the name adopted by a group of people who believe they are being stalked, harassed, and controlled through various mental weapons. As a recent New York Times article wrote, "They raise money, hold awareness campaigns, host international conferences and fight for their causes in courts and legislatures." *See* Mike McPhate, *United States of Paranoia: They See Gangs of Stalkers*, N.Y. TIMES (June 10, 2016), https://www.nytimes.com/2016/06/11/health/gang-stalking-targeted-individuals.html?_r=0. As the article details, they are now organizing themselves through the Internet. I spoke at a meeting of the President's Council for Study of Bioethical Issues that was to be the Council's first discussion of neuroethics. The public comment period was entirely taken up by thirty of so self-identified targeted individuals who urged that the most important neuroethics question was the unethical nature of what was being done to them. Over the last dozen years, more than two dozen people with similar delusions have reached out to me, personally, for help in getting rid of their controlling devices. It is the saddest part of my job. I have yet to find any way that I can help them or lead them to help.

A first possibility, although currently fictional, would be truly effective hypnosis. Though a plot feature in fiction, the subject of at least one 1955 law review article calling for statutory action,[27] and the subject of a subsection of the Model Penal Code,[28] I can find no evidence of a reported opinion concerning an "I did it involuntarily while under hypnosis" defense. And the current scientific consensus seems to be that hypnosis cannot force an unwilling subject to do something strongly against his or her values.[29] Whether it could tilt the balance enough to cause criminal behavior in someone who was somewhat, but not entirely, unwilling to commit the crime seems less clear.

James Rathmell brought a second interesting fictional version of "perfect control" to my attention, the movie *Memento*.[30] The plot (spoiler alert) concerns a man with anterograde amnesia (he cannot make new memories) who is manipulated into committing many murders by evidence suggesting that his victims had murdered his wife.

For better or for worse, after returning from fiction and its edges, the real world provides only weak analogies — so far.

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[27] *See generally* Sheldon S. Levy, *Hypnosis and Legal Immutability*, 46 J. CRIM. L. CRIMINOLOGY & POLICE SCI. 333 (1955). Levy argued that there was an urgent need for legislation dealing with a) criminal acts arguably consented to by their victims because of hypnosis, b) crimes committed by hypnotized subjects, and c) admissibility of hypnosis-induced evidence. *Id.* at 345-46. The latter received attention, largely after ruining the lives of people prosecuted for child sexual abuse based on hypnotically retrieved "repressed memories." *See* Sheila Taub, *The Legal Treatment of Recovered Memories of Child Sexual Abuse*, 17 J. LEGAL MED. 183 (1996). As to the first two, Levy seems to have overestimated the state of the science.

[28] "[C]onduct during hypnosis or resulting from hypnotic suggestion" is not considered voluntary for the purposes of *actus reus*. MODEL PENAL CODE § 2.01(2)(c) (AM. LAW INST., Proposed Official Draft 1962). "Nearly every jurisdiction has declined to follow the lead of the Model Penal Code. California courts have allowed defendants to present the defense, although to date it appears that all attempts have been unsuccessful in gaining an acquittal." 2 CRIM. L. DEF. § 191(b) (2016 update) (footnotes omitted). This article on hypnotism as a criminal defense does refer briefly to an 1895 Kansas case where the person who committed the murder was acquitted on the ground he had been hypnotized into doing it; the alleged hypnotist was convicted of the murder. *Id.* at n.13 (citing State v. Gray, 55 Kan. 135 (1895)).

[29] *See Hypnosis Today: Looking Beyond the Media Portrayal*, AM. PSYCHOLOGICAL ASS'N, http://www.apa.org/topics/hypnosis/media.aspx (last visited Mar. 19, 2018) ("Contrary to some depictions of hypnosis in books, movies or television, people who have been hypnotized do not lose control over their behavior. . . . Hypnosis makes it easier for people to experience suggestions, but it does not force them to have these experiences."). *See generally* THEORIES OF HYPNOSIS: CURRENT MODELS AND PERSPECTIVES (Steven Jay Lynn & Judith W. Rhue eds., 1991).

[30] *See* MEMENTO (Summit Entertainment 2000).

As long as a dozen years ago neuroscientists demonstrated that they could "force" monkeys to make specific kinds of arm movements by stimulating particular parts of their brains through implanted electrodes.[31] (Because of the nature of their research subjects, they were unable to ask them the fascinating question whether the monkeys thought something was forcing them to move their arms or they were choosing to do so of their own free monkey will.) What if, realizing the nightmare delusions of targeted individuals, they did that to a person?[32] Presumably, the person would not be held accountable for any damage done while under the researchers' control.

Another, more current version comes from some side effects to treatments for Parkinson's disease, whether by drugs or by deep brain stimulation. A non-trivial number of people receiving those treatments develop, out of the blue, serious gambling addictions, hyper-sexuality, or compulsive shopping.[33] It seems that the treatments their brain is receiving "made them" do it, but who will be affected and how much seems unpredictable, and uncontrollable, at this point.

Perhaps a third example of the "perfectly controllable" person is someone acting under duress that *cannot* be withstood. A person who was forced, by the physical intervention of a stronger person, to push a button causing some wrongful harm could be viewed as someone who was, in relevant ways, perfectly controlled. In a different sense, a

[31] *See generally* Michael S. A. Graziano, Tyson N. S. Aflalo & Dylan F. Cooke, *Arm Movements Evoked by Electrical Stimulation in the Motor Cortex of Monkeys*, 94 J. NEUROPHYSIOL 4209 (2005). A similar result had been reached several decades earlier by Jose Delgado, a professor at Yale Medical School, who used electrodes in monkeys' brains to force them to move their arms and, more famously, activated electrodes in a bull's brain to force it to turn aside from a bullfighter it was charging. Video of this experiment can be found widely on the Internet; one such excerpt appears in a 1985 CNN Special Report: Electromagnetic Frequency Weapons. *See CNN Special Report: Electromagnetic Frequency Weapons*, (CNN television broadcast Nov. 1, 1985), https://archive.org/details/CNNSpecialReport1985ElectromagneticFrequencyWeapons (experiment at 00:04:10).

[32] Reportedly Delgado did implant electrodes for this kind of control in at least twenty-five humans, largely to control aggressive behavior. *See generally 1950s: Jose Delgado, MD, Pioneered Wireless Implanted Electrode to Control Human Behavior*, ALLIANCE FOR HUM. RES. PROTECTION, http://ahrp.org/1950s-jose-delgado-md-pioneered-wireless-implanted-electrode-to-control-human-behavior/ (last visited May 21, 2017). I have been unable, thus far, to find scientific journals reporting those experiments.

[33] *See* M. Leann Dodd et al., *Pathological Gambling Caused by Drugs Used to Treat Parkinson Disease*, 62 ARCHIVES NEUROLOGY 1377 (2005); Thomas J. Moore, Joseph Glenmullen & Donald R. Mattison, *Reports of Pathological Gambling, Hypersexuality, and Compulsive Shopping Associated with Dopamine Receptor Agonist Drugs*, 174 JAMA INT. MED. 1930 (2014).

parent threatened with the immediate death (or worse) of his or her children if, say, illegal orders were not obeyed seems, at least to this parent, another possible example of what should be an excuse from accountability as a result of being "controlled." These can be viewed as examples of the absence of any voluntary "act" in a criminal case or as examples of duress, but both situations share convincing evidence of the "acting" person being effectively controlled.

Apart from perfectly predictable and perfectly controllable, consider another kind of behavior that seems unaccountable though neither (exactly) predictable nor controllable: random behavior. Let's say a person flips a coin every minute to decide whether to turn left or right. Her behavior is predictable in general (she will turn left or right every sixty seconds) but not in which direction she will move next, let alone where she will end up. Similarly, the details of her route cannot be said to be determined by a controlling will external to herself, unless the die is credited with a "will." It is possible that the random method is being forced on her so her *general* course of behavior is controlled but not her *actual* course of movement.

Thus random behavior, too, seems to usefully negate evidence of the lack of an ability to control one's actions. It would be useful evidence but not necessarily determinative — presumably a person could consciously and intentionally use a random number generator to determine her thus personally controlled next actions. Assuming the person has not put herself under such random "control" but has had it thrust upon her, it scarcely seems right to hold her accountable for her random acts. Alas — except, perhaps, from a deeply and peculiarly disordered mind, I can think of no plausible examples of this kind of human behavior.

The practical implications of my "predictability" and "controllability" arguments for humans seem minimal today. Perhaps neuroscience in the future will lead to more examples in one or the other or both cases. But the predictability argument does fulfill an important function for me — it might provide an escape from one broad neuroscience approach to the lack of free will.

Neuroscientists can easily use some form of this syllogism:

1. "The mind is wholly created by or through the state of (the physical) brain" and
2. "the state of the physical brain at time T1 is totally a function of its state at time T0 plus whatever inputs it has received," therefore
3. "the mind is completely determined."

This theoretical kind of determinism is deduced from basic principles and not induced from observation.[34] It seems to me quite possible that it is true. In fact, apart from what seems self-evidently (to me) hand waving, I cannot see how it can *not* be true.

In that case, except in the (attractive but, again, to me, unconvincing) solutions of some philosophical compatibilists,[35] I would say we have no free will. An adequate computer, given all relevant data about the universe from the pico-second at the start of the Big Bang, might be able to predict, with complete accuracy, my next sentence. So might an omniscient deity — and so thought, and confessed, the Reformation's believers in providence, predestination, and double predestination, some of whom proceeded to settle New England.[36] But if, to avoid accountability, one were to require an actual ability to predict, with a high (or possibly perfect) degree of certainty that behavior, our practical inability to do so might introduce a kind of "free will (or accountability) by uncertainty" that might be, at least, somewhat satisfying.

B. Children

Before leaving people for robots and artificial intelligences, consider one more example. What is the accountability of new human beings and the people who unleash them upon the world? Infants are, in relevant ways, awfully predictable, especially before they can move around. And many of their behaviors are actually controlled, by their parents or caregivers. They are also, to pull in the feature of the dog and cat story that has not been mentioned so far in this section, almost entirely harmless. This may have some relevance to a thus-far barely discussed source of accountability: ultra-hazardous activities. (Recall that keeping dangerous wild animals subjects the keeper to strict liability for all harm they do.)

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[34] See, as an introduction, PINK, *supra* note 3.

[35] Philosophers fall into several categories with respect to free will. The first division is between determinists (the position set out above) and indeterminists. The indeterminists may or may not have a traditional view of free will. The determinists then fall themselves into two main groups, compatibilists and incompatibilists. Compatibilists believe determinism is compatible with free will; incompatibilists do not. This is a very rough sketch of a very complicated landscape; for more detail, see PINK, *supra* note 3. And, for the best, and very alluring but ultimately (to me) unconvincing, defense of compatibilism, see JOHN M. FISCHER, MY WAY: ESSAYS ON MORAL RESPONSIBILITY (2006).

[36] *See* DIARMAID MACCULLOCH, THE REFORMATION: A HISTORY 234-37 (2003).

At some point those infants become adults (and, even worse, teenagers): unpredictable, uncontrollable, and often at least superficially random. During those transitions their own accountability for their actions goes up. This is true, for example, in criminal liability. It does not exist at all below a certain age, it exists (in its juvenile system form) for intermediate years, in many jurisdictions it can be imposed in either juvenile or adult forms during teenage years. Eventually, (usually at eighteen) it is imposed in its full adult form.

The accountability of parents over their children — as their creators, or their controllers — is complicated. The Anglo-American common law, unlike the civil law system, does not automatically hold parents accountable for their children's torts. Accountability can follow from a parents' negligent supervision causing harm, from a statute, and in limited circumstances, from vicarious liability akin to that of an employer for an employee.[37]

Ultimately, in spite of parental pride, or guilt, the actions of mature, or "maturish," children are their own, not their parents'. Increasing rationality and self-control can surely be invoked as reasons for this. Decreasing predictability and controllability and increasing power to harm may also play a role.

Is it worth thinking about having (some?) children as ultra-hazardous activities? It would seem harsh — and counterproductive to the continuation of our species — to consider the process of having (and raising) children as always an ultra-hazardous activity. Nevertheless, what about the accountability of parents who knowing, or, worse, intentionally, have an ultra-hazardous child? One Dutch family led to the discovery of a mutation in the gene that leads the body to produce a protein called Monoamine Oxidase A.[38] This mutation makes the gene non-functional; the affected boys make none of the protein, which is involved in transporting some neurotransmitters, crucial brain chemicals. The mutation, apparently inevitably, leads the boys who carry it[39] to have a condition called

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[37] *See* S. Randall Humm, Comment, *Criminalizing Poor Parenting Skills as a Means to Contain Violence by and Against Children*, 139 U. PA. L. REV. 1123, 1128-30, 1145-46 (1991).

[38] *See Brunner Syndrome: #300615*, OMIM, http://www.omim.org/entry/300615 (last visited May 21, 2017) [hereinafter *Brunner Syndrome*].

[39] A brief genetics lesson: the MAO-A gene is on the X chromosome. Women have two copies of the X chromosome, one inherited from each parent. Men only have one copy, inherited always from their mothers. Diseases caused by genes on the X chromosome are much more likely to be expressed in males because they do not have the chance to get another, "good" copy of the gene on their (non-existent) "other" X

Brunner syndrome: "[A] novel form of X-linked nondysmorphic mild mental retardation. All affected males in the family showed characteristic abnormal behavior, in particular aggressive and sometimes violent behavior. Other types of impulsive behavior included arson, attempted rape, and exhibitionism."[40]

Would a parent with a child with Brunner syndrome be like a person who owned a tiger — or a dog known for a "vicious propensity" to bite and thus subject to strict liability for an "ultra-hazardous activity"? Or, projecting out (not far) into the future of human reproduction, would parents who affirmatively selected an embryo that would turn into a child with Brunner syndrome, or edited DNA so that their child *would* have Brunner syndrome, have that kind of accountability?[41]

But, of course, genetic interventions may be unnecessary. Systematic mistreatment of a child might be able to produce an ultra-dangerous person. What should we think about the accountability of the mistreaters in those cases?

Let me sum up this section. First, if the acting person's behavior can be perfectly and completely predicted, he or she will not be viewed as accountable for them. If there is an entity that has caused his actions to be predictable, it might be accountable; in many cases, nothing will be. Second, if the acting person's behavior is completely controlled in relevant part by some other entity, he or she will not be viewed accountable for that action, except perhaps if that acting person is responsible for putting himself under that control. The controller should be accountable in either case, either jointly or singly. Third, an acting person whose behavior is entirely random will not be viewed as accountable, but any entity, including the person, who caused the person's behavior to be random would be accountable. Fourth, there may be some circumstances where the "creator" of a particularly dangerous person might be held strictly accountable on the similarity to ultra-hazardous activities. The absence of many real examples of these situations, at least based on today's knowledge of neuroscience and neuroscientific tools, may seem to make this long discussion not just literally academic. But I hope the arguments might be useful in thinking about the next two categories: robots and genomically modified species.

chromosome. Some of these X-linked diseases found much more often in males include some forms of hemophilia, colorblindness, and muscular dystrophy.

[40] *See Brunner Syndrome*, *supra* note 39.

[41] *See generally* HENRY T. GREELY, THE END OF SEX AND THE FUTURE OF HUMAN REPRODUCTION (2016).

III. ROBOTS AND ARTIFICIAL INTELLIGENCE

I first presented, and drafted, this section knowing that some legal scholars, notably Ryan Calo, had been writing about the accountability of robots and artificial intelligence[42] but I had very little familiarity with *what* they were writing. It turns out that most, and quite possibly all, of what I concluded about accountability in these contexts has already been published, some over thirty-five years ago.[43] In a remarkably prescient article from 1981, Sam N. Lehman-Wilzig, an Israeli political scientist without a background in law, laid out seven possible approaches to the liability of artificial intelligence: product liability; dangerous animals; slavery; diminished capacity; children; agency; and personhood.[44] The subsequent decades have seen a deepening and complication of this discussion, occurring perhaps faster than actual progress toward artificial intelligence (at least until recent years). Scholars have taken many different positions and made many different arguments on these issues.[45] The following paragraph is not exhaustive; neither are the cited works for each point. (Note that some talk of AI, some of robots, and some use other terms. All are relevant to this discussion.)

An early focus was on the responsibility between the operator and the manufacturer.[46] People then began to look harder at what standards to apply to whomever, or whatever, was liable. Some argued for general negligence standards,[47] some for strict liability,[48] some for the "personhood" liability of the AI.[49] Others argued for special

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

[43] Or so says Professor Calo (and, in a somewhat more circumspect way, my research assistant).

[44] Sam N. Lehman-Wilzig, *Frankenstein Unbound: Towards a Legal Definition of Artificial Intelligence*, 13 FUTURES 442, 447-53 (1981).

[45] My indefatigable research assistant, James Rathmell, presented me with a memorandum summarizing thirty-two articles or books.

[46] *See* Steven J. Frank, *Tort Adjudication and the Emergence of Artificial Intelligence Software*, 21 SUFFOLK U. L. REV. 623, 647-48 (1987); Andrea Bertolini, *Robots as Products: The Case for a Realistic Analysis of Robotic Applications and Liability Rules*, 5 L. INNOVATION & TECH. 214, 237-38 (2013).

[47] George S. Cole, *Tort Liability for Artificial Intelligence and Expert Systems*, 10 COMPUTER L.J. 127, 213-15 (1990).

[48] Marguerite E. Gerstner, *Liability Issues with Artificial Intelligence Software*, 33 SANTA CLARA L. REV. 239, 266-68 (1993); Paulius Cerka et al., *Liability for Damages Caused by Artificial Intelligence*, 31 COMPUTER L. & SECURITY REV. 376, 386-87 (2015).

[49] *See* Lehman-Wilzig, *supra* note 44, at 447-53; *see also* Anita Bernstein, *How Can a Product Be Liable?*, 45 DUKE L.J. 1, 81-82 (1995); Bert-Jaap Koops et al., *Bridging the Accountability Gap: Rights for New Entities in the Information Society?*, 11 MINN. J.L. SCI. & TECH. 497, 559-61 (2010); Leon Wein, *The Responsibility of Intelligent Artifacts:*

schemes — a liability insurance requirement,[50] a choice between limited and strict liability based on whether the AI had been certified,[51] or treatment under general negligence standards rather than strict liability for AI that can be shown to be safer (on average) than humans.[52] Several published ideas about evolving liability frameworks, changing with both the changes in AI and with changes in the law.[53] Others focused on particular applications of AI: to autonomous cars[54] and ships,[55] to healthcare[56] or eldercare,[57] and to autonomous lethal weapons.[58] The potential criminal liability of robots or AI has been analyzed in depth.[59] One writer discussed in

Toward an Automation Jurisprudence, 6 HARV. J.L. & TECH. 103, 111-16 (1992).

[50] *See* Curtis E.A. Karnow, *Liability for Distributed Artificial Intelligences*, 11 BERKELEY TECH. L.J. 147, 202-04 (1996).

[51] Matthew U. Scherer, *Regulating Artificial Intelligence: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J.L. & TECH. 353, 394, 398-400 (2016).

[52] Ryan Abbott, *The Reasonable Computer: Disrupting the Paradigm of Tort Liability*, 86 GEORGE WASH. L.R. 102, 140-43 (2018).

[53] Ugo Pagallo, *What Robots Want: Autonomous Machines, Codes and New Frontiers of Legal Responsibility*, *in* HUMAN LAW AND COMPUTER LAW: COMPARATIVE PERSPECTIVES, 25 IUS GENTIUM, at 47 (Mireille Hildebrandt & Jeanne Gaakeer eds., 2013); Mark A. Chinen, *The Co-Evolution of Autonomous Machines and Legal Responsibility,* 20 VA. J.L. & TECH. 338, 390-93 (2016); David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 146-50 (2014).

[54] Sabine Gless et al., *If Robots Cause Harm, Who is to Blame? Self-Driving Cars and Criminal Liability*, 19 NEW CRIM. L. REV. 412, 435-36 (2016); Bryant Walker Smith, *Automated Vehicles Are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411, 419 (2014).

[55] Michal Chwedczuk, *Analysis of the Status of Unmanned Commercial Vessels in U.S. Admiralty and Maritime Law*, 47 J. MAR. L. & COM. 123, 168 (2016).

[56] Jessica S. Allain, *From Jeopardy! to Jaundice: The Medical Liability Implications of Dr. Watson and Other Artificial Intelligence Systems*, 73 LA. L. REV. 1049, 1051-52 (2013); Jason Chung and Amanda Zink, *Hey Watson, Can I Sue You for Malpractice? Examining the Liability of Artificial Intelligence in Medicine*, ASIA-PACIFIC J. HEALTH L., POL'Y & ETHICS (forthcoming 2018) (manuscript at 1-2), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3076576; Amanda Swanson & Fazal Khan, *The Legal Challenge of Incorporating Artificial Intelligence into Medical Practice*, 6 J. HEALTH & LIFE SCI. L. 90 (2012); Nicolas P. Terry, *When the "Machine That Goes Ping" Causes Harm: Default Torts Rules and Technologically-Mediated Health Care Injuries*, 46 ST. LOUIS U. L.J. 37, 37-38 (2002).

[57] Pericle Salvini, *On Ethical, Legal and Social Issues of Care Robots*, *in* INTELLIGENT ASSISTIVE ROBOTS: RECENT ADVANCES IN ASSISTIVE ROBOTICS FOR EVERYDAY ACTIVITIES, 106 SPRINGER TRACTS IN ADVANCED ROBOTICS, at 431 (Samer Mohammed ed., 2015).

[58] Nathan Reitinger, *Algorithmic Choice and Superior Responsibility: Closing the Gap Between Liability and Legal Autonomy by Defining the Line Between Actors and Tools*, 51 GONZ. L. REV. 79 (2015).

[59] *See generally* GABRIEL HALLEVY, LIABILITY FOR CRIMES INVOLVING ARTIFICIAL INTELLIGENCE SYSTEMS (2015); Gabriel Hallevy, *The Criminal Liability of Artificial*

detail animal liability analogies, similar to what I describe here, while several mention the animal parallels.[60] And another author has even discussed legal issues around robots as owners of real property![61]

So, the bad news is that this section may not be particularly novel; the good news is that if I have that much company among law professors (and others), I am, somewhat, less likely to be crazy. And, in any event, this discussion should help bring out some of the connections, or at least parallels, between the AI discussions and issues of biology — in human neuroscience, human reproduction, and, ultimately, in genetically modified (or human created) biological organisms.

Let us start with "robots." Ryan Calo defined "robots" as

> mechanical objects that take the world in, process what they sense, and in turn act upon the world. The utility here of the so-called sense-think-act paradigm lies in distinguishing robots from other technologies. A laptop with a camera can, to a degree, sense and process the external world. But a laptop does not act upon the world. A remote-control car with a camera senses and physically affects its environment but relies on the human operator for processing. The idea of a robot or robotic system is that the technology combines all three.[62]

I prefer a somewhat broader definition, to mean all programmable machines that, in whole or in part, do not rely on moment-to-moment close control by a human. This differs from Calo's definition mainly in his "sensing" or, perhaps, "processing" branches.[63]

Consider, for example, a microwave oven. It is, to me, a "robot": you set it to run on high for sixty seconds and that is what it does before automatically stopping. It might also be a robot for Calo, if, for example, it senses the food's temperature and modifies its power or

Intelligence Entities — from Science Fiction to Legal Social Control, 4 AKRON INTELL. PROP. J. 171 (2010); Gabriel Hallevy, *"I, Robot — I, Criminal" — When Science Fiction Becomes Reality: Legal Liability of AI Robots Committing Criminal Offenses*, 22 SYRACUSE SCI. & TECH. L. REP. 1 (2010).

[60] Richard Kelley et al., *Liability in Robotics: An International perspective on Robots as Animals*, 24 ADVANCED ROBOTICS 1861 (2010). Lehman-Wilzig, Bernstein, Bertollini, and Hallevy (in his 2015 book) also discuss the animal analogy.

[61] David Marc Rothenberg, *Can Siri 10.0 Buy Your Home? The Legal and Policy Implications of Artificial Intelligent Robots Owning Real Property*, 11 WASH. J.L. TECH. & ARTS 439 (2016).

[62] Calo, *supra* note 42, at 529-30 (citations omitted).

[63] Professor Calo tells me that electrical engineers prefer my definition while computer scientists prefer his.

timing as a result. The Roomba, a floor cleaning device, is another robot. It keeps cleaning floors until it hits an obstruction. It then changes direction in a largely random way and keeps going again until it is obstructed. (As "healthy" Roombas travel in straight lines, one need not worry about a constant, and inefficient, circling.)[64] A self-driving car is a much more sophisticated robot.

This definition, however, can get murky if pressed too far. Even a conventional car is a robot in some respects. No driver has to tell a car powered by an internal combustion engine exactly when and exactly how much fuel to inject into the cylinders and most modern cars have anti-lock brakes that will override a driver's ineffective braking pattern and substitute its own. And the laptop computer I am writing this on, although it needs me to type (or dictate) the words, does a myriad of things automatically without my knowledge or control.[65]

"Artificial intelligence," on the other hand, is an attribute that a robot may, or may not possess — but, equally importantly, may not be embodied in an identifiable machine that we could call a robot. Artificial intelligence "in the cloud" can be in many different machines, some of which are simultaneously "doing" other things that do not involve artificial intelligence.

But regardless of the exact definition of robot (or artificial intelligence), the question for this essay is what are our culture's norms likely to conclude about who, if anyone, is accountable for their actions. In his 1981 article Lehman-Wilzig did not offer a conclusion about which kind of liability should be adopted and when, but concluded, it would be best to leave the issue to future generations. It has been thirty-seven years since his publication and his "future generations" are arriving.

Some of what I call robots, such as microwave ovens, if you grant them the name "robots" at all, are extremely stupid robots. But their behavior, at least when working properly, is perfectly controllable and predictable. (At least, that is true when they have a competent user — do not ask how well I understand my television remote controls these days.) It would seem to go without saying that these machines would

[64] I remember from my youth in Southern California that there were machines that would clean the bottom of swimming pools using the same concept. Propelled by a water jet, they would keep going and, on a curved pool, would always end up turning away from obstructions. Often, however, the curved pool surface would lead them to flip over on their "backs" and stop moving around. I would consider them stupid robots; Calo would not, I think, view them as robots at all.

[65] Ryan Calo tells me that he has used exactly the same examples in some of his work, but I believe this falls in the "great (?) minds think alike" category.

not be viewed as accountable in some way for their wrongs. They are the agents of their creators. Those who control them (by manufacturing them or by their near-term programming) have that accountability, and any consequent liability. One might conceptualize this as product liability, at least for the manufacturer or the creator of the general programming if different from the manufacturer. (The software creator might be liable under a product liability theory rather than the computer manufacturer for harms the computer "causes" because of the software.) That does not necessarily fit well with the "short term" programming by the user of the robot; the user who tells the microwave to cook something too long, at too high a power, and so causes damage. To me, the latter situation with robots not acting with their own artificial intelligence seem better viewed as vicarious liability of a principal for the actions of its agent within the scope of the agency.[66]

But what happens when machines behave in ways that are not predictable (to humans at least) and that are controlled by artificial intelligence entities? These may be more than agents of their creators, or, to switch the legal metaphor, they may be more "independent contractors" than "employees."[67] An employer has vicarious liability for the actions of its employees, at least when those actions are within the scope of their duties. They are not generally liable for the physical harms caused by their independent contractors.[68]

It seems to me that, consistent with how we treat humans whose actions are not completely predictable, completely controlled, or completely random (i.e., competent adult humans, at least most of the time), it may make more sense to think about robots as responsible, though not necessarily excluding the possibility of holding their creators or programmers somewhat accountable.

Am I really proposing treating artificial intelligence as somehow *personally* accountable for harms done by machines it controls? I think so.[69] And I have two different time-honored analogies. One is

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[66] *See* RESTATEMENT (SECOND) OF TORTS § 409 (AM. LAW INST. 1965); *see also Meyer v. Holley*, 537 U.S. 280, 285 (2003) ("It is well established that traditional vicarious liability rules ordinarily make principals or employers vicariously liable for acts of their agents or employees in the scope of their authority or employment." (citing RESTATEMENT (SECOND) OF AGENCY § 219(1))).

[67] This idea is not novel with me. *See supra* note 39.

[68] *See* RESTATEMENT (THIRD) OF TORTS § 57 (2012) ("[A]n actor who hires an independent contractor is not subject to vicarious liability for physical harm caused by the tortious conduct of the contractor.").

[69] I am not the first to make such a suggestion. *See, e.g.*, Peter M. Asaro, *A Body to Kick, but Still No Soul to Damn: Legal Perspectives on Robotics*, *in* ROBOT ETHICS: THE

corporations. Corporate entities are "legal" but "artificial" persons. It is hard to put them in prison, but they can be held both civilly and criminally responsible (and their officers can be put in prison on their behalf). They have assets that can be used to pay the damages or fines they are assessed; they can be enjoined and those injunctions enforced through the threat of more fines (and possibly imprisonment for those "real" humans in charge of them).

But a second, and possibly more interesting analogy, is *in rem* jurisdiction — lawsuits against things, not people. Some of these have wonderful names, like *United States v. 50 Acres of Land*,[70] *United States v. One 1980 Rolls Royce*,[71] or *United States v. $734,578.82 in U.S. Currency*.[72] The closest analogy is in admiralty jurisdiction, where ships themselves can be defendants and can be seized, and sold, to satisfy judgments.[73] These actions can follow when there is a lien against the ship, typically in cases where the ship was involved in a maritime tort or the breach of a maritime contract. The federal courts have exclusive jurisdiction in admiralty cases and have, on occasion, employed it creatively to make ships available to satisfy good claims where the ship owners might not be easily sued, or easily collected from.[74]

What if artificial intelligence were treated as a kind of person, subject to those sanctions? One might well want to make sure that it had assets that could be used to pay its liabilities. Before allowing use of an artificial intelligence entity, the law could require that it be "endowed," through insurance or otherwise, with assets sufficient to

ETHICAL AND SOCIAL IMPLICATIONS OF ROBOTICS 169-86 (Patrick Lin et al. eds., 2011). And I would note that a report from the EU Parliament suggested doing just this in 2017. Eur. Parliament Comm. on Legal Affairs, Rep. with Recommendations to the Comm'n on Civil Law Rules on Robotics, PARL. EUR. DOC. 582.443v03-00 (2017), http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+REPORT+A8-2017-0005+0+DOC+PDF+V0//EN. The proposal has been controversial. Open Letter to the European Commission: Artificial Intelligence and Robotics (2017), http://www.robotics-openletter.eu/; *see also* Rachel Withers, *The EU Is Trying to Decide Whether to Grant Robots Personhood*, SLATE (April 17, 2018), https://slate.com/technology/2018/04/the-eu-is-trying-to-decide-whether-to-grant-robots-personhood.html.

70 469 U.S. 24, 24 (1984).

71 905 F.2d 89, 89 (5th Cir. 1990).

72 286 F.3d 641 (3d Cir. 2002).

73 Supplemental rules C and E of the Federal Rules of Civil Procedure govern maritime arrests. A vessel can be arrested, or seized, pursuant to rule C, and sold pursuant to rule E. FED. R. CIV. P., SUPP. ADM. R. C, E.

74 *See, e.g.*, CHRISTIAN G. FRITZ, FEDERAL JUSTICE IN CALIFORNIA: THE COURT OF OGDEN HOFFMAN, 1851–1891, (1991).

discharge its plausible debts. (States do something of the sort by insisting that motor vehicles can be legally operated only when they — technically their registered owners, but in some sense "they" — have liability insurance).[75] Enforcing injunctions might be even easier by, for example, adding programming that requires compliance with the court order. One might even imagine ways of "imprisoning" or "punishing" an artificial intelligence through putting it into a situation that it might find or feel unpleasant or even painful. (This, of course, depends on just what the capacities of the artificial intelligence are.)

One question might be whether to focus the legal accountability on the "robot" — the machine that is controlled by the artificial intelligence — or the artificial intelligence itself. I incline to the latter, but do not feel strongly about it.

Note that imposing liability on the artificial intelligence directly does not necessarily mean that its creator, producer, manufacturer, owner, lessor, or seller (or some or all of the above) may not also have derivative liability. Consider the hospital. The doctors on the medical staff are almost never employees of the hospital (unless they are trainees or are in a few particular specialties). Instead, they are independent contractors with the hospital (as are hospital-employed nurses and other ancillary personnel when under the direct control of the independent contractor physician or surgeon, under the so-called "Captain-of-the-Ship" doctrine).[76] The hospital can still be held liable, not for the torts of the staff physicians, but for its own negligence in giving them staff privileges and letting them retain those privileges.[77] This is a negligence standard, unlike the direct and unavoidable vicarious liability of an employer for its employees' misdeeds when they occur within the scope of their employment. It would also be similar to the liability of parents for some actions of their minor children if, for example, improperly supervised.

Along with many earlier commentators, it seems to me that it may make more sense to think of the liability of the producer or manufacturer (or programmer?) of a robot or artificial intelligence

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[75] *See Liability Laws*, AAA: DIGEST OF MOTOR LAWS, http://drivinglaws.aaa.com/tag/liability-laws/ (last visited May 17, 2018).

[76] *Captain-of-the-Ship Doctrine*, BLACK'S LAW DICTIONARY (10th ed. 2014) ("In medical-malpractice law, the doctrine imposing liability on a surgeon for the actions of assistants who are under the surgeon's control but who are employees of the hospital, not the surgeon.").

[77] Kenneth S. Abraham & Paul C. Weiler, *Enterprise Medical Liability and the Evolution of the American Health Care System*, 108 HARV. L. REV. 381, 386-92 (1994) (describing imposition of agency and corporate liability on hospitals).

producer not in terms of strict product liability, but rather in this secondary negligence sense. This is particularly appropriate when the artificial intelligence can be sued independently — and required to fulfill any judgments against it. There could still be strict liability in some sensitive or dangerous uses of artificial intelligence, akin to the tort liability for engaging in ultra-hazardous activities. This could also be viewed, at least in part, as the "riskiness" difference between dogs (dangerous) and cats (not so dangerous).

IV. GENETICALLY MODIFIED ORGANISMS AND CRISPR

This essay was written as a result of a workshop on legal issues raised by neuroscience and artificial intelligence — why does it include genetically modified organisms?

Because, like human beings (at least under our current understanding of human neuroscience) and artificial intelligence, genetically modified organisms are neither very predictable nor very controllable.[78] Life reproduces itself and, between responses to different environments and internal genomic mutations, changes itself with unexpected consequences.

Note that this unpredictability does not just apply to genomically modified species, but to many exotic species, organisms that have ended up, almost always by human intervention, in new environments. Thus, the 100 starlings Eugene Schieffelin released in Central Park in 1890 and 1891 gave rise to the more than 200 million starlings currently in North America.[79] It can also apply to species that have not moved but whose environment has substantially changed. And coyotes, confronted with a continent rapidly deprived of wolves by humans, spread across most of North America, hybridizing with domestic dogs and the remaining wolves as they colonized not just states but suburbs and cities.[80] Either way, the spread and the behaviors of species can change in very unpredictable ways, with surprising consequences for the environment.

The interaction between environments (or ecosystems) and species new to them gives rise to the unpredictability. The ability of these

[78] It is also the case that this area — humanly modified or created biological organisms — is my main current scholarly interest.

[79] Scott Keyes & Daniel Karp, *The Shakespeare Fanatic Who Introduced All of the Bard's Birds to America*, PAC. STANDARD (May 29, 2014), https://psmag.com/environment/shakespeare-fanatic-introduced-bards-birds-america-82279.

[80] Sarah Deweerdt, *Part Coyote, Part Wolf, Part Dog: Enter the Coywolf*, NEWSWEEK (Dec. 22, 2015, 1:57 AM), http://www.newsweek.com/2016/01/08/part-coyote-part-wolf-part-dog-enter-coywolf-407868.html.

organisms to reproduce on their own, without human support or intervention, makes them less controllable than, say, washing machines.

Many parts of the world have experienced the problems of exotic species, from the devastation that rodents have created in New Zealand and other island ecosystems, to the problems created by rabbits and cane toads in Australia; green tree snakes in Guam; kudzu, zebra mussels, Asian clams, the fungal Dutch elm disease, and starlings in North America; phylloxera in European vineyards; and many other examples. Sometimes the transfers were intentional, often they were accidental, but their disastrous effects were never predicted. And controlling the resulting invasive species has proven both extremely expensive and supremely difficult.[81]

Genetically modified organisms are another kind of new, and potentially invasive species. Humans have not only imported, knowing and accidentally, existing species to new environments during our migrations; we have also created and spread new species. The domestic dog and cat and various livestock were created by our geneticist ancestors through domestication and selective breeding. Wheat, maize, rice, and the other crops with which we have transformed almost all arable land in the world are human creations, vastly different from the grasses that were their natural precursors. Wheat, for example, is the result of human crossing of at least three different grass species.[82]

CRISPR offers the possibility of a great expansion of this kind of creation of new species. A domestic pig with a genomically edited resistance to a pig virus is a new kind of pig. An American chestnut tree engineered to resist the deadly chestnut blight is a new type of chestnut tree. A mosquito engineered to resist infection with malaria — not for the purpose of improving the mosquito's health but so it cannot pass the disease on to humans — is a new type of insect. Since its discovery in 2012, CRISPR has made DNA editing an order of magnitude, or cheaper, faster, easier, and more accurate.[83] It is the

[81] A cynic might say, in the words of Pogo, that, as to the worst invasive species, "we have met the enemy and he is us." Homo sapiens have spread over almost the entire land surface of the world in about the last 50,000 years, bringing vast upheavals and destruction to existing ecosystems, not least through the invasive species they have brought with them. From the perspective of the biosphere we are a metastatic and very dangerous cancer.

[82] *The History of Wheat*, JOHN INNES CENTER & INST. FOOD RES., http://www.allaboutwheat.info/history.html (last visited Mar. 18, 2019).

[83] *See* NAT'L ACADS. OF SCI., ENG'G, & MED., HUMAN GENOME EDITING: SCIENCE, ETHICS, AND GOVERNANCE (Nat'l Acads. Press 2017), https://doi.org/10.17226/24623;

Model T of DNA editing, making something that was expensive, unreliable, and rare into something everyone can own, and use.

CRISPR also comes with its own enhancing technology — the gene drive.[84] Gene drives allow for the much faster spread of a new trait through any sexually reproducing population. Consider an engineered organism where each individual has two copies of a new gene version, call it "A," where the wild population has two copies of the "natural variant," which we'll call "a." Release engineered individuals into the wild and their mating with the non-engineered individuals will necessarily result in a first generation that has, at the relevant gene, one A and one a. When two first generation individuals mate, their offspring will be one quarter AA, one quarter aa, and one half Aa (or aA). Gene drive uses CRISPR to change the genes of the offspring. So, in the first generation, the CRISPR construct will transform those individuals from Aa to AA, and so on in the next generation, and the next, and the next. The A version could take over the entire population in just a few generations, though the process will not be entirely predictable — and, once launched, not obviously controllable.

Humans will use CRISPR, and its successors, to engineer the living world. Much of that will be agricultural purposes, especially as climate puts new stress on the growing conditions for common crops. Some of it may well be for the malignant purpose of biological warfare, with deeply unpredictable and uncertain consequences. But others will use it to bring back extinct species, create blue roses, modify pets, make unicorns or dragons, or just make "genomic art projects."[85]

I believe that we need to grapple, immediately, with a new regulatory strategy for genomically modified organisms, one that does not allow their release into the environment without a favorable, or at least neutral, assessment of their risks and benefits. But the discussion in this essay about accountability might also be relevant. Neither the humans who create these new organisms, nor those who regulate them, can predict perfectly their effects. Additionally, the spread and activity of these new organisms cannot be easily controlled. A regulatory scheme should not only include *ex ante* risk assessments

see also JENNIFER A. DOUDNA & SAMUEL H. STERNBERG, A CRACK IN CREATION: GENE EDITING AND THE UNTHINKABLE POWER TO CONTROL EVOLUTION (Houghton Mifflin Harcourt 2017).

[84] *See* NAT'L ACADS. OF SCI., ENG'G, & MED., GENE DRIVES ON THE HORIZON: ADVANCING SCIENCE, NAVIGATING UNCERTAINTY, AND ALIGNING RESEARCH WITH PUBLIC VALUES (Nat'l Acads. Press 2016), https://doi.org/10.17226/23405.

[85] *See* R. Alta Charo & Henry T. Greely, *CRISPR Critters and CRISPR Cracks*, 15 AM. J. BIOETHICS 11, 11-15 (2015).

before allowing release, but also *ex post* methods to try to control unanticipated effects of those releases and to compensate for the harm done.

As with artificial intelligence, one could imagine the new organism itself as being accountable. That accountability, again, could be realized by assets, insurance, or other methods of paying claims. For some kinds of releases, a strict liability, along the lines of ultra-hazardous activity liability, might be appropriate. In other circumstances — say, the addition of blight resistant genes to the American chestnut — the potential harms may be so low that a more permissive accountability scheme, perhaps derivative liability built on negligence in the design or release of the organisms, would be appropriate.

It might also be appropriate to impose measures, or incentives for the sponsors of the new organisms to impose their own measures, to make the organisms more controllable. So-called "kill switches" or perhaps gene drives that limit themselves to a few generations might be examples of such increased control approaches. (And note that the same kinds of rules could be imposed on at least intentional releases of exotic species into new environments, though many or most of those releases are likely to be accidental and quite likely untraceable.)

Using predictability and controllability as touchstones for accountability might also help us think about the uses of this new technology.

LAST THOUGHTS

Let me end with one more example, one that combines several of the categories discussed above. CRISPR could be used not just on non-human organisms, but on humans.[86] What if it was used on humans in a way that made them more predictable or controlled — or, at least, made their characteristics more predicted and controlled by those who chose the genomic variations to be edited? These might well be parents, but could, in some scenarios, be governments, health care institutions, or even artificial intelligence. Does this increase in predictability and controllability similarly increase the accountability of the "choosers" for the behavior of the resulting humans? Michael Sandel suggested as much more than a decade ago.[87] My framework suggests he may be right.

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[86] See the new report from the National Academies of Sciences, Engineering, and Medicine on the use of CRISPR in humans, *supra* note 84 at 2-3.

[87] Michael J. Sandel, *The Case Against Perfection: What's Wrong with Designer*

I remain uncertain whether this approach to accountability will prove useful (not to mention whether it is at all novel). But the idea grabbed my imagination as I thought about and then wrote this essay, causing it to be longer and quite different from what I expected. I suspect it is worth at least some exploration.

Children, Bionic Athletes, and Genetic Engineering?, 293 ATLANTIC MONTHLY 3, 60-61 (Apr. 2004).