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Andrea M. Matwyshyn

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THE INTERNET OF BODIES

ANDREA M. MATWYSHYN*

ABSTRACT

This Article introduces the ongoing progression of the Internet of Things (IoT) into the Internet of Bodies (IoB)—a network of human bodies whose integrity and functionality rely at least in part on the Internet and related technologies, such as artificial intelligence. IoB devices will evidence the same categories of legacy security flaws that have plagued IoT devices. However, unlike most IoT, IoB technologies will directly, physically harm human bodies—a set of harms courts, legislators, and regulators will deem worthy of legal redress. As such, IoB will herald the arrival of (some forms of) corporate software liability and a new legal and policy battle over the integrity of the human body and mind. Framing this integrity battle in light of current regulatory approaches, this Article offers a set of specific innovation-sensitive proposals to bolster corporate conduct safeguards through regulatory agency action, contract, tort, intellectual property, and secured transactions and bankruptcy.

Yet, the challenges of IoB are not purely legal in nature. The social integration of IoB will also not be seamless. As bits and bodies meld and as human flesh becomes permanently entwined with hardware,
software, and algorithms, IoB will test our norms and values as a society. In particular, it will challenge notions of human autonomy and self-governance. Legal scholars have traditionally considered Kantian autonomy as the paradigmatic lens for legal determinations impacting the human body. However, IoB threatens to undermine a fundamental precondition of Kantian autonomy—Kantian heautonomy. Damaged heautonomy renders both Kantian autonomy and deliberative democracy potentially compromised. As such, this Article argues that safeguarding heautonomy should constitute the animating legal principle for governance of IoB bodies. The Article concludes by introducing the companion essay to this Article, The Internet of Latour’s Things. This companion essay inspired by the work of Bruno Latour offers a sliding scale of “technohumanity” as a framework for the legal and policy discussion of what it means to be “human” in an age where bodies are the “things” connected to the Internet.
# Table of Contents

**INTRODUCTION** ........................................... 81

I. THE INTERNET OF (HUMAN) THINGS: DEFINING THE
“INTERNET OF BODIES” ........................................ 89
   A. Three Generations of IoB ..................................... 91
      1. First-Generation IoB: Body External .................. 94
      2. Second-Generation IoB: Body Internal ................. 103
      3. Third-Generation IoB: Body Melded .................... 112
   B. The “Legacy Code” of IoT .................................. 115
      1. The Better with Bacon Problem: Gratuitous Internet Connectivity ......................... 116
      2. The Magic Gadget Problem: Failing to Anticipate Failure ........................................ 118
      3. The Builder Bias Problem: Shipping Without Securing .............................................. 121
      4. The Mandatory Soup Problem: Diminishing Market Choice and Obsolescence Through Adhesion. .... 124
   C. The Future of Corporate Software Liability and IoB ........................................ 129
      1. Regulatory Agencies ......................................... 130
         a. FDA ................................................. 130
         b. FTC ................................................ 133
         c. CPSC ................................................ 135
         d. CFPB ............................................... 136
         e. FCC ............................................... 137
      2. Tort .................................................... 138
      3. Contracts ............................................... 143
         a. EULAs ............................................... 144
         b. Criminal Law and the Third-Party Doctrine .......... 147
      4. Intellectual Property ...................................... 148
         a. Patent ............................................. 148
         b. Copyright .......................................... 151
      5. Secured Transactions and Bankruptcy .................... 153

II. KANTIAN HEAUTONOMY ..................................... 156
   A. Why Autonomy Fails with IoB ............................... 156
      1. Owned Bodies Versus Pwned Bodies ..................... 157
      2. Autonomy Versus Heautonomy ............................ 159
B. Humanity—Bug or Feature? ......................... 165
Conclusions: The (Cyber)Pancreas and the Panopticon . . 167
INTRODUCTION

“[F]reedom of thought ... is the matrix, the indispensable condition, of nearly every other form of freedom.”
—J. Benjamin Cardozo.¹

“This is your last chance. After this, there is no turning back. You take the blue pill—the story ends, you wake up in your bed and believe whatever you want to believe. You take the red pill—you stay in Wonderland and I show you how deep the rabbit-hole goes.... Remember ... all I’m offering is the truth. Nothing more.”
—Morpheus, The Matrix.²

We are building an “Internet of Bodies”—a hybrid society where computer code and human corpora blend and where the human body is the new technology platform. In November 2017, the Federal Drug Administration (FDA) approved the first use of a “digital pill”³ that communicates from inside the patient’s stomach through sensors,⁴ a smartphone,⁵ and the Internet.⁶ A year earlier, the FDA

⁴. Sensors for monitoring body functions may be as small as one millimeter. Amelia Heathman, This 1mm Sensor Could Monitor Your Body in Real-Time, WIRED (Aug. 4, 2016), http://www.wired.co.uk/article/wireless-sensors-monitor-body [https://perma.cc/FUB6-SD9Q].
approved the first artificial pancreas—a device for Type 1 diabetics that is hard-wired into patients’ bodies and relies on software to calibrate insulin levels on an ongoing basis.7

These FDA approvals are a harbinger of the next generation of innovation, one that merges the Internet of Things8 and artificial intelligence with the human body. This “platformization” of the body holds great promise: it is already leading to groundbreaking changes in healthcare and in lifestyle convenience.9 However, using the human body as a platform also introduces new categories of possible harm to the confidentiality, integrity, and availability of the bodies used as part of the hardware.10

Three months prior to the digital pill’s approval, in August 2017, the FDA issued a safety communication warning patients with a particular implanted pacemaker that they should visit their doctors immediately for a firmware11 update.12 The notice warned patients that a potentially serious security vulnerability in the code of their embedded medical device might enable a third-party attacker to compromise their pacemaker system and potentially physically harm them.13 This communication marked a critical moment in the history of innovation: it was the first FDA recall of a device solely for an information security issue.14

10. Id.
11. Firmware is computer code built into a piece of hardware. Margaret Rouse, Definition: Firmware, WHATIS.COM (Apr. 2017), https://whatis.techtarget.com/definition/firmware [https://perma.cc/VL6M-R7KB].
13. Id.
The August 2017 pacemaker security recall was not, however, the first time that computer code put human bodies at risk of physical harm and death. Indeed, a year prior, a patient’s heart surgery had been unexpectedly interrupted for five minutes when one of the Internet-enabled machines attached to the patient’s body crashed. The machine had unexpectedly performed an anti-malware scan in the middle of the operation and locked up the human interface—the interface upon which the surgeons were relying to keep the patient alive.

This creeping merger of bodies with bits and bytes is also not limited to medical contexts. Employers are throwing “chip[ping] part[ies],” embedding their employees’ bodies with chips that


15. See, e.g., Anne Marie Porrello, Death and Denial: The Failure of the THERAC-25, A Medical Linear Accelerator (unpublished computer science paper) (on file with California Polytechnic State University), http://users.csc.calpoly.edu/~jdalbey/SWE/Papers/THERAC25.html [https://perma.cc/5X8L-4ZPN] (chronicling death or severe radiation injury to patients due to software malfunction).


17. [I]n the middle of a heart catheterization procedure, the hemo monitor pc lost communication with the hemo client and the hemo monitor went black. Information obtained from the customer indicated that there was a delay of about 5 minutes while the patient was sedated so that the application could be rebooted. It was found that anti-malware software was performing hourly scans.


19. Fortunately, the heavily sedated patient survived the operation, but this outcome was not guaranteed. Id.

20. In its FDA incident report, the manufacturer of the equipment blamed the hospital technicians for a misconfiguration, stating that prominent disclaimers existed with the accompanying materials. MAUDE Adverse Event Report, supra note 17.

connect with other devices and transmit information from employees’ bodies. Trucking companies sometimes now expect their drivers to wear clothing or devices that monitor location and alertness and (ostensibly) “improve” job performance. Manufacturers


24. Although current chips generally do not transmit location, the capability is expected in the future. Gillies, supra note 21 (“A future version of the microchip could include GPS, and if an employee leaves the company, it won’t be removed.”).


of “brain sensing” Internet-enabled headbands encourage “professionals” to use the device to monitor a “client’s” brain sensations in real time. Simultaneously, these same companies might encourage consumers to use the headbands to facilitate “meditation,” and developers to build out games and other applications incorporating brain data. Other brain sensing headbands are appearing in classrooms, signaling to teachers and remote parents when children are (allegedly) paying attention in class. Meanwhile, consumers are donning augmented reality devices in


33. See Join the Muse Professional Community, MUSE PROFESSIONAL, https://choosemuse.com/muse-professionals/ [https://perma.cc/8J7F-K685] (“A personalized dashboard tracks your clients’ at-home meditation practice with Muse, so you can view their progress in real time.”)


gaming,38 and they are purchasing clothes39 and accessories40 that connect their bodies to the Internet, sharing corporeal information about themselves in real time.41 Some consumers are even recreationally implanting chips into their bodies for the sake of convenience,42 allowing their bodies to perform some of the tasks their phones do now.43 In short, we are experiencing a creeping transformation where human bodies themselves are becoming connected to and sometimes reliant upon software, hardware, and the Internet for portions of their “default” functionality. This is the Internet of Bodies.

In addition to transforming individual bodies,44 these Internet of Bodies devices also introduce a new level of peril for society in the aggregate. For the first time in our civilization, computer code will be able to physically damage (civilian) human bodies at scale. In other words, particularly as artificial intelligence becomes incorporated into the Internet of Bodies, the confidentiality, integrity, and availability of some human bodies will inevitably become compromised due to flawed and vulnerable software, either individually or en masse: the security compromises that plague our networks, devices, and databases today will shift inside (and physically damage) the human body tomorrow. Yet, the law is currently unprepared to


42. Chips have been used with animal identification for over a decade. Morris, supra note 22.


44. For example, the first Cyborg Olympics recently unveiled some of the innovation in progress in IoB technology. Bloomberg (@business), TWITTER (Nov. 17, 2016, 4:50 PM), https://twitter.com/business/status/799414438675632128 [https://perma.cc/C4Y5-9AZ7] (“Welcome to the first cyborg Olympics.”).
address these harms and the social transformation that the Internet of Bodies will occasion.

This Article introduces and explains this (already happening) progression of the Internet of Things or “IoT” into the Internet of Bodies or “IoB.”45 As the “meatware”46 of human bodies blends with software, hardware, and related technologies47 in the Internet of Bodies era, jurists, legislators, and scholars will be faced with a dual


47. In particular, machine learning algorithms and “artificial intelligence” become increasingly common as part of the functionality of Internet of Bodies devices. All of the concerns regarding security articulated in this Article extend to the machine learning components of IoB devices. Additionally, machine learning introduces a series of other code integrity risks depending on the nature of its functionality. These issues are explored in detail in Andrea M. Matwyshyn, Artifice and Intelligence (unpublished manuscript) (on file with author).
IoB legal challenge. First, they will need to address the unresolved policy and legal quandaries presented by the Internet of Things. Second, they will face a formidable challenge in addressing what a programmer might call the legal “legacy code”\(^{48}\) problem of software liability more broadly. Just as companies struggle to address the “technical debt”\(^{49}\) of their systems, the law now faces a somewhat parallel “legal technical debt” challenge. Multiple traditional bodies of law have failed to meaningfully update themselves across time to effectively address changing technology circumstances. As a consequence, resolving this “legal technical debt” will be doctrinally buggy as courts and regulators seek to redress and mitigate bodily harms caused by computer code: crafting suitable methods of redress for both physical and economic IoB harms will implicate a series of sometimes conflicting policy concerns.

Part I introduces the progression of IoT into IoB. Explaining three discrete generations of IoB—body external, body internal, and body melded—Part I locates our current social reality in this progression at stage two—body internal. Yet, using patent filings to reveal expected innovation, Part I argues that late second-generation body internal and early third-generation body melded technologies are already being actively developed. Next, Part I articulates four legacy problems of IoT that will impact the nature of future harms caused by IoB—the “better with bacon” problem of gratuitous Internet reliance and connection, the “builder bias” problem of extreme levels of known (but uncorrected) security vulnerability, the “magic gadget” problem of failing to anticipate failure, and the “mandatory soup” problem of diminishing consumer options for self-help. Part I then presents five areas of law where conflicts over IoB will be most pronounced—guidance from regulatory agencies, contracts, tort, intellectual property, and secured transactions and bankruptcy. Finally, Part I offers concrete approaches for building short term innovation-sensitive legal structures of IoB consumer protection.

Part II then expands on the critical difference between IoB and IoT: IoB’s propensity to physically damage human bodies and

\(^{48}\) See infra Part I.B.

minds. IoB presents the specter not only of negative consequences with respect to physical and psychological autonomy—in a Kantian sense—but also, even more fundamentally, third-generation IoB threatens to potentially erode Kantian heautonomy—the necessary precursor to autonomy. For these reasons, Part II argues that the touchstone for all regulation of IoB must be the safeguarding of heautonomy. Part II concludes by asking an uncomfortable theoretical question about our underlying assumptions regarding the human body: should the law assume the body to be a “bug” or a “feature”? The companion essay to this Article, The Internet of Latour’s Things, grapples with the question of whether future law will view the corporeality of the human body as worthy of preservation (or elimination) in a society full of IoB bodies. Part III concludes.

I. THE INTERNET OF (HUMAN) THINGS: DEFINING THE “INTERNET OF BODIES”

Morpheus: The Matrix is everywhere. It is all around us. Even now, in this very room. You can see it when you look out your window or when you turn on your television. You can feel it when you go to work ... when you go to church ... when you pay your taxes.50

In the 1999 movie The Matrix, a computer programmer named Thomas A. Anderson, who uses the handle “Neo,” finds out that the physical reality he experiences is actually a computer-generated illusion.51 After taking a mysterious red pill, he discovers that underneath the superficially placid exterior of the world he inhabits, there lurks a linked invisible society of machine overlords.52 The machines are powered by energy extrusions from millions of human bodies that have been physically networked together.53 This web of bodies—the Matrix—allows the machine overlords to harness and commodify the bodies of humans, turning them into merely the

50. THE MATRIX, supra note 2.
51. Id.
52. Id.
53. Id.
“hardware” that powers both the machines and the software that perpetuates the simulacrum of the human-viewable world.54

The Matrix is, of course, just a movie; a majority of scientists do not believe that the world we currently inhabit is merely an illusion generated by a computer program.55 However, we are unquestionably entering a technological age where the line between the human body and the machine is beginning to blur.56 Many human bodies will soon become at least occasionally reliant on the Internet for some aspect of their functionality,57 and the energy of the human body is already being used experimentally to mine cryptocurrency.58 Just as the Internet of Things has networked our possessions into a “cloud”59 of shared gadgetry, so too our bodies are slowly becoming networked into an “Internet of Bodies.”60

54. Id.
58. As the Institute for Human Obsolescence has described it: “A single human body at rest radiates 100 watts of excess heat.... The electricity generated is then fed to a computer that produces cryptocurrency.” Biological Labour, INSTITUTE OF HUMAN OBSOLESCENCE, http://speculative.capital/ [https://perma.cc/Q8SA-7459]; see also Daniel Oberhaus, You Could Mine 1 Bitcoin Per Month If You Harvested the Body Heat from 44,000 People, VICE: MOTHERBOARD (Jan. 3, 2018, 10:00 AM), https://motherboard.vice.com/en_us/article/vby7ny/bitcoin-body-heat-mining [https://perma.cc/T8SH-57D2].
59. For a discussion of “the cloud,” see, for example, Margot E. Kaminski, Robots in the Home: What Will We Have Agreed to?, 51 IDAHO L. REV. 661, 670 (2015). Most robots will share information with third parties for processing purposes or just to store information in the cloud. Id.
60. For examples of devices in the Internet of Bodies, see infra notes 88-93 and accompanying text.
A. Three Generations of IoB

Morpheus: The pill you took is part of a trace program. It’s designed to disrupt your input/output carrier signal so we can pinpoint your location.
Neo: What does that mean?
Cypher: It means fasten your seat belt Dorothy, ‘cause Kansas is going bye-bye.61

In an iconic 1960 episode of The Twilight Zone, a misanthropic writer becomes convinced that the appliances in his home are conspiring against him, attempting to intimidate him.62 His escalating tensions with the machines culminate in his typewriter, television, and telephone informing him that he needs to leave and in his electric shaver menacing him.63 Ultimately, his car “encourages” his untimely exit.64

Despite recent reports of home smart assistants laughing manically and scaring their owners,65 today’s Internet of Things—meaning the totality of consumer and other devices that connect to the Internet66—usually reflects a less menacing version of The Twilight Zone’s sentient appliances.67 According to some estimates, the number of IoT devices is expected to reach twenty-one billion devices by the year 2020.68 These devices include everything from

61. THE MATRIX, supra note 2.
63. Id.
64. Id.
66. See U.S. FED. TRADE COMM’N, INTERNET OF THINGS, supra note 8, at 5-6 (summarizing the findings of a workshop held earlier in the year on the topic).
67. However, a recent first-person account of a technology journalist chronicled her begging her home IoT devices to make her a cup of coffee, and a later “emotional” overreaction from her coffee machine due to her absence. See Kashmir Hill & Surya Mattu, The House that Spied on Me, GIZMODO (Feb. 7, 2018, 1:25 PM), https://gizmodo.com/the-house-that-spieled-on-me-1822429852 [https://perma.cc/5N8S-34SN].
According to a recent Federal Trade Commission (FTC) report, our society is merely “at the beginning of this [IoT] technology trend.” While asserting that IoT devices potentially offer substantial benefit to consumers in connected medicine and other contexts, the FTC report highlighted the concerning reality that our existing legal paradigms are not optimally suited for the Internet of Things context. In particular, the FTC explained that IoT has created challenges for meaningful consumer consent, privacy, and security.

In a consonant vein, Professor Scott Peppet has argued that in the Internet of Things “the near impossibility of truly de-identifying ... data, the likelihood that Internet of Things devices will be inherently prone to security flaws, and the difficulty of meaningful consumer consent in this context—create very real discrimination, privacy, security, and consent problems.” Other scholars have

74. See U.S. FED. TRADE COMM’N, INTERNET OF THINGS, supra note 8, at i.
75. “Staff acknowledges the practical difficulty of providing choice when there is no consumer interface and recognizes that there is no one-size-fits-all approach.” Id. at v.
77. Professor Peppet provides the example of an Internet of Things breathalyzer explaining: “the consumer is essentially led to the incorrect assumption that this small black device is merely a good like any other—akin to a stapler or ballpoint pen—rather than a data source and cloud-based data repository.” Id. at 90.
78. Peppet, for example, argues in favor of data minimization and use constraints: “As a first regulatory step, we should constrain certain uses of Internet of Things data if such uses...
focused on behavioral impacts occasioned by a world permeated by the Internet of Things. For example, Professor Meg Leta Jones has asserted that the goal of the Internet of Things, which she dubs the “Internet of Other Peoples’ Things,” is to enable “ubiquitous connection” and that “[p]erforming the boundary work necessary to managing one’s information becomes increasingly difficult as we move deeper into the Information Age.” Professor Paul Ohm and Blake Reid have asked what it means to regulate software when everything around us contains software. Meanwhile, Professor Christina Mulligan has argued that as software becomes increasingly present in consumer goods, Internet of Things merchants will use the licenses to the software contained in these devices to undesirably and materially, contractually restrict both the permitted uses and resale or transfer of devices. Finally, Professor Irina Manta and David Olson have argued that while Internet of Things “[p]rice

thwart consumer expectations.” Id. at 150.

80. Peppet explains the consent problem as follows:
The technical problem is simple: coupled with Big Data or machine learning analysis, massive amounts of sensor data from Internet of Things devices can give rise to unexpected inferences about individual consumers. Employers, insurers, lenders, and others may then make economically important decisions based on those inferences, without consumers or regulators having much understanding of that process. This could lead to new forms of illegal discrimination.

Id. at 118.

81. Id. at 85. Peppet advocates four approaches to regulating the Internet of Things: (1) broadening existing use constraints—such as some state law on automobile EDRs—to dampen discrimination; (2) redefining “personally identifiable information” to include biometric and other forms of sensor data; (3) protecting security by expanding state data-breach notification laws to include security violations related to the Internet of Things; and (4) improving consent by providing guidance on how notice and choice should function in the context of the Internet of Things.

Id. at 149.
83. Id. at 641.
84. Id. at 645.
discrimination can increase total market welfare in some cases, especially in comparison to monopoly pricing; it also can decrease total market welfare if the pricing is done in such a way as to decrease allocative efficiency."

Building on this prior scholarship, this Article asks what it means for existing legal paradigms and for the next generation of innovation when the “things” that are attached to the Internet are human bodies. In brief, this Article argues that this “Internet of human things” or, more succinctly, this “Internet of Bodies” will cause us to materially reframe our legal conversations when computer code regularly begins to cause physical harms to human bodies. But before embarking on this legal analysis, let us define the Internet of Bodies and assess how it mirrors and differs from the Internet of Things.

The Internet of Bodies might be divided into three generations of technologies—body external, body internal, and body melded. 88

1. First-Generation IoB: Body External

The first generation of IoB devices has already become a familiar fixture in our lives. These devices are seemingly ubiquitous, including everything from “lifestyle” connected fitness tracking devices89 and “smart” glasses90 to “smart” exoskeletons,91 connected breast pumps,92 and brain-sensing93 headbands.94 Specifically, these

88. See infra Parts I.A.1-3.
91. See Timothy Burke, Paraplegic in Robotic Exoskeleton Performs World Cup First Kick, DEADSPIN (June 12, 2014, 3:19 PM), https://deadspin.com/paraplegic-in-robotic-exoskeleton-
93. These headbands include headbands for patients lacking motor function. See Mark Honigsbaum, Could This $300 Headset Transform the Lives of ‘Locked-In’ Patients?, GUARDIAN (July 11, 2014, 6:00 AM), https://www.theguardian.com/technology/2014/jul/11/
first-generation IoB devices encompass three categories of body-external products—IoB “medical devices” approved by the FDA,95 “general wellness”96 IoB devices that present “low risk” and promote “healthy lifestyle” (and are, therefore, not regulated by the FDA),97 and various other non-health enterprise, educational, and recreations body-attached devices that connect to the Internet, directly or indirectly.98

First-generation IoB medical devices include devices such as Internet-enabled robotic surgery machines99 and connected prosthetics100 that a patient operates from a mobile phone.101 In comparison, the “general wellness/lifestyle” first-generation IoB category encompasses familiar devices such as fitness trackers,102 health
monitoring tattoos, electronic skin with an organic circuit, and “smart” watches with lifestyle monitoring capability.

But it is the last category of these first-generation IoB devices—enterprise, educational, and recreational devices—that presents perhaps the fastest growing category of first-generation IoB devices. For example, connected glasses and helmets regularly offer workers information in real time in enterprise settings, and exoskeleton projects for soldiers offer new fighting capabilities. Brain sensing headbands that rely on external EEG electrodes are now used in some classrooms, seeking to monitor student attention. Recent patent filings indicate that Amazon has developed a wristband that conducts ultrasonic tracking of a worker’s hands to monitor efficiency in performance of an assigned task, and providing


110. See WALL ST. J., supra note 37.

111. U.S. Patent Application No. 15/083,083, Pub No. 2017/0228051 (filed Mar. 28, 2016) (published Sept. 28, 2017) (Amazon Technologies, Inc., applicant), http://pdfa.gov/aiw?PageNum=0&docid=20170228051&IDKey=0E2634BC1119&HomeUrl=http%3A%2F%2Fappft.uspto.gov%2Fnetacgi%2Fnph-Parser%3FSect1%3DPTO1%2526Sect2%3DHITOFF%2526d%3DPGO1%2526p%3DI%2526s%3D2%2Fnetahmtl%2FPTO%2FSrchnum.html%2526r%3DI%2526s%3D2%2526d%5D0%2526s%5D2%2526s%5D20170228051.PGNR.%2526s%3D [https://perma.cc/CPV5-D-CVXC].
haptic feedback to guide the employee’s hands in the correct direction.\textsuperscript{112} Clothing company L.L.Bean has announced that it is connecting its coats and boots to the blockchain\textsuperscript{113} using sewn-in sensors,\textsuperscript{114} becoming the latest participant in the broader fashion trend of connected clothing\textsuperscript{115} with human-computer interfaces.\textsuperscript{116} The Massachusetts Institute of Technology and Microsoft Research have developed temporary tattoos a wearer attaches to her body, allowing her to control various devices wirelessly as a convenience.\textsuperscript{117} Gaming devices such as virtual skin\textsuperscript{118} and augmented\textsuperscript{119} or virtual reality headsets\textsuperscript{120} allow for recreational blending of physical and digital reality. Networked in-ear translators help with live multilingual communication,\textsuperscript{121} and eye-mapping applications\textsuperscript{122} turn


\textsuperscript{113} For a discussion of blockchain technology and how “the recent development of Bitcoin and blockchain technologies has rekindled excitement about their potential among technologists and industry,” see Kevin Werbach & Nicolas Cornell, Contracts Ex Machina, 67 DUKE L.J. 313, 313 (2017).


\textsuperscript{116} For example, connected underwear has been developed to assist workers in lifting tasks as a type of exoskeleton. Maya Dangerfield, Lab-Created Underwear Could Prevent Back Pain, CNN BUS. (Aug. 30, 2017), http://money.cnn.com/video/technology/future/2017/08/30/lab-created-underwear-could-prevent-back-pain.cnnmoney/index.html [https://perma.cc/KQ2A-CL3E].


\textsuperscript{118} See The Verge (@verge), TWITTER (July 6, 2017, 11:50 PM), https://twitter.com/verge/status/883216517776773120 [https://perma.cc/UVD7-KLWQ] (“This ‘wearable skin’ makes virtual reality feel way too real.”).


\textsuperscript{121} See David Pierce, Doppler’s Futuristic Earbuds Sound Great. They Also Speak Spanish, WIRED (Oct. 19, 2016, 6:56 AM), https://www.wired.com/2016/10/doppers-futuristic-earbuds-sound-great-also-speak-spanish [https://perma.cc/Y5Y5-MB5E]; Discover the Technol-
eyes into a mouse. Similarly, both Facebook and Microsoft have disclosed that each company is currently working on brain-control interfaces that will allow users to operate computing devices with only their thoughts and the help of external thought-sensing devices. Meanwhile, Nissan has announced work on “[b]rain-to-vehicle” technology that will allow drivers to use “signals from their own brain to make the drive even more exciting.” These
many examples highlight the reality that IoB is already here and quickly expanding. These examples also portend that our future is one where IoB is likely to be legally and socially transformational, for better or worse.\footnote{REG. (Jan. 4, 2018, 6:18 PM), https://www.theregister.co.uk/2018/01/04/nissan_brain_controlled_car_wheeze/ [https://perma.cc/63W9-DMZ9].}

It is noteworthy that unlike many of the earliest first-generation IoB devices whose stated purpose was “self-archival,” i.e., a user’s personal data collection for self-reflection and tracking,\footnote{See supra notes 74-87 and accompanying text.} today’s first-generation IoB devices often explicitly disclose that furthering third-party “big data” research\footnote{See supra notes 102-06 and accompanying text.} is a prime motivator for their data collection.\footnote{For example, DNA samples are uploaded and available through the Internet allowing for cloud-based user analysis in real time. João Medeiros, DNA Analysis Will Build an Internet of Living Things, WIRED (Jan. 8, 2016), http://www.wired.co.uk/article/dna-analysis-internet-living-things [https://perma.cc/GGX9-7UEA].} This “big data” motivation in particular often drives IoB products marketed for employment and educational settings.\footnote{In a medical context, the U.K.’s National Health Service has experimented with Google DeepMind’s Stream application. Jo Best, DeepMind and the NHS: What It’s Really Like to Use Google’s Kidney Health App, ZDNET (Jan. 10, 2018, 11:00 AM), http://www.zdnet.com/article/deepmind-and-the-nhs-what-its-really-like-to-use-googles-kidney-health-app/ [https://perma.cc/9YTC-4TGU].}

In one case, a brainwave headband company targeted educational institutions,\footnote{As explained by Kate Crawford and Jason Schultz, “it is possible to generate a detailed picture about a person’s health, including information the person may never have disclosed to a health care provider.” Kate Crawford & Jason Schultz, Big Data and Due Process: Toward a Framework to Redress Predictive Privacy Harms, 55 B.C. L. REV. 93, 98 (2014).} ostensibly to assist with monitoring students’ attention levels\footnote{Reviews of both the science behind the product and its efficacy have been mixed, at best, with one critique calling it “malfunctioning” and “cringeworthy.” Ad Dellinger, This Malfunctioning Brain-Scanning Headband Was the Most Cringeworthy Demonstration at CES 2016, DAILY DOT (Jan. 14, 2016, 1:21 AM), https://www.dailydot.com/debug/brainco-brain-control-technology-ces/ [https://perma.cc/6JLB-A5WL]; Paige Rogers, Company to Collect Brain Wave Data on 1.2 Mil Students in the Classroom, NOQ REP. (Dec. 4, 2017), https://noqreport.com/2017/12/04/company-collect-brain-wave-data-1-2-mil-students-classroom/ [https://perma.cc/793W-ZQYV].} in educational settings.\footnote{Other brain sensing headband research similarly focuses on attention-level monitoring. Alexandra Simon-Lewis, This Brain-Imaging Headband Can Reveal How Boring You Are, WIRED (Feb. 27, 2017), http://www.wired.co.uk/article/brain-imaging-headband-com municate [https://perma.cc/9TSP-DVB5].} The company also recently

\footnote{Ms. Smith, Company with No Privacy Policy to Collect Brainwave Data on 1.2 Million Students, CSO (Dec. 5, 2017, 9:00 AM), https://www.csoonline.com/article/3239969/security/}
announced its intention to collect data on over a million students to create “the world’s biggest brainwave database.” In another case, the “Brainternet” project used external EEG nodes and a Raspberry Pi computer to connect a human brain to the Internet in real time in order to continuously monitor brain activity; its creators hope to build a brain application programming interface with bidirectional inputs and outputs.

Legal scholarship has considered a portion of this innovation in the context of what was initially known as the “Quantified Self” movement, primarily assessing the medical desirability and privacy implications of connected devices with health applications. Professor Nicolas Terry expands this analysis to issues of autonomy and data control, explaining that the Quantified Self movement presents an inherent dichotomy of control—while patient collection of “medically inflected” data is encouraged, the definite copy of a...
health record will always reside with the medical provider. Similarly, Professor Craig Konnoth explains that the Quantified Self movement positions itself as a way of “knowing oneself,” and Professor Frank Pasquale warns that the Quantified Self combined with Big Data offer “frightening opportunities to cure and exploit human vulnerabilities.”

Building on the era of the Quantified Self, the age of the Internet of Bodies presents the next iteration of these concerns: IoB adds legal concerns regarding the physical safety and continued functionality of the attached human bodies themselves. It also adds a new autonomy question: the inability to disconnect in some cases. Use of some IoB devices becomes progressively less optional. Perhaps your employer or your school now requires that you wear a location tracking badge or perhaps your medical device manufacturer (mandated by your insurance provider) discontinues all devices without Internet connectivity. In other words, IoB impacts legal interests in physical safety—the integrity, availability, and functional autonomy of human bodies, not merely legal concerns with respect to the confidentiality of data originating from those bodies.

Thus, IoB transforms legal questions of data commodification into legal questions about the commodification and physical control of the human body itself. Indeed, the newest first-generation IoB devices sometimes invert the relationship between the attached body and the remote machines, using human bodies purely as fungible and rentable commodities for their physicality and energy

142. Nicolas P. Terry, Big Data Proxies and Health Privacy Exceptionalism, 24 HEALTH MATRIX 65, 84 (2014) (“At root such patient curation of health data bespeaks autonomy.... However, it fails to take into account ... the canonical version of the record will remain in the provider’s control ... [and] that only the provider-curated copy is protected by HIPAA-HITECH.... A similarly dichotomous result is likely as the medically quantified self develops.”).

143. Craig Konnoth, Health Information Equity, 165 U. PA. L. REV. 1317, 1341-42 (2017) (“[T]he ‘quantified-self’ movement promotes data streams as the best form of self-conceptualization and knowledge. This movement promotes the use of devices that not only ‘solve problems related to health,’ but also produce data ... as a way of knowing oneself.”) (footnote omitted).


145. See infra notes 283-93 and accompanying text.

146. See id.
extrusion, a non-data driven purpose. For example, one Japanese inventor developed a way to rent another person’s body as a telepresence “robot” to allow someone to attend a meeting both physically and remotely.147 In another case, research using external caps of brain electrodes enabled gamers to control the conduct of another player’s body through the Internet in order to play a question-and-answer game.148 Finally, a Dutch startup recently developed suits intended to extract heat from the human body and repurpose it for cryptocurrency mining.149 Referring to these first-generation IoB cryptocurrency mining suits, Professor Mark Lemley recently quipped, “It only took 18 years for us to actually implement the Matrix.”150

Professor Lemley’s dark humor points to an important and perhaps ethically uncomfortable inversion—the human body is now being leveraged as a functional vehicle to power external, Internet-connected processes.151 Even when the research described above seeks to generate mature interface technologies152 with tangible safety153 and other154 applications, the “thing-ified” nature of the human body implicit in the undertaking may trigger safety and dignitary concerns (and incredulous callbacks to “body snatcher”

147. Will Knight (@willknight), TWITTER (Jan. 29, 2018, 10:52 PM), https://twitter.com/willknight/status/958231499509149697 [https://perma.cc/6R3C-VNSS] (”‘Human Uber,’ developed in Japan, provides a way to attend events remotely using another person’s body.”).


151. See INSTITUTE OF HUMAN OBSOLESCENCE, supra note 58.


153. Dvorsky, supra note 148 (“[F]or example, the brain of a sleepy airplane pilot dozing off at the controls could stimulate the copilot’s brain to become more alert.”).

154. George Dvorsky, New Brain-Link Tech Means We Can Now Play 20 Questions with Our Minds, GIZMODO (Sept. 25, 2015, 3:00 PM), https://io9.gizmodo.com/new-brain-link-tech-means-we-can-now-play-20-questions-1732991346 [https://perma.cc/BYY5-S84F] (“The researchers are hopeful, for example, that a similar system could be used by people with Broca’s aphasia.”).
movies). These uncomfortable questions of third-party processes controlling human bodies become even more pronounced in the context of second-generation IoB—IoB devices that are embedded inside the body.

2. Second-Generation IoB: Body Internal

Second-generation IoB technologies refer to those IoB devices where a portion of the device resides inside the body or accesses the body by breaking the skin. For example, pacemakers have long included digital components, and cochlear implants now include functionality reliant on Bluetooth. Digital pills (already approved for the market by the FDA) rely on a 3D-printed circuit and a transmitter inside a capsule. Along similar lines, several companies are currently racing to bring an IoB artificial “pancreas”


159. *FDA Approves Pill with Sensor that Digitally Tracks if Patients Have Ingested Their Medication*, U.S. FOOD & DRUG ADMIN. (Nov. 13, 2017), https://www.fda.gov/newsevents/newsroom/pressannouncements/ucm584933.htm [https://perma.cc/C92K-CJLR] (“Abilify MyCite (aripiprazole tablets with sensor) has an ingestible sensor embedded in the pill that records that the medication was taken.”).


to market—an implantable Internet-connected, sometimes 3D printed163 “pancreas” managed by software and a mobile phone app.164 Indeed, the FDA has already approved the first of these artificial pancreas devices.165 Sensor-enabled sutures can now collect data on healing wounds,166 and chips with cameras can report information from inside the heart during surgery.167

Prosthetics manufacturers have also embarked upon “smart” product168 development, announcing that the next generation of

system-aimed-at-type-1-diabetes-mellitus/ [https://perma.cc/Z8ZH-29CA] (“The artificial pancreas is not a replica organ; it is an automated insulin delivery system designed to mimic a healthy person’s glucose-regulating function.”). Intended as a next generation insulin pump, these devices would engage in continuous monitoring of a patient’s glucose levels, releasing insulin into the body when needed. Admetsys to Exhibit Smart Pancreas™, supra note 161.


164. Karoff, supra note 162 (“The closed-loop system consists of an insulin pump, a continuous glucose monitor placed under the user’s skin, and advanced control algorithm software embedded in a smartphone that provides the engineering brains, signaling how much insulin the pump should deliver to the patient based on a range of variables, including meals consumed, physical activity, sleep, stress, and metabolism.”).


168. For example, one such prosthesis uses “15 different sensors that are measuring different parameters with every step that the person is taking, and that data is being processed by three different onboard computers.” Rob Hawley, Wounded Veteran Among Those Benefiting from ‘Smart’ Prosthetic Ankle, CBS N.Y. (Nov. 18, 2015, 2:54 PM), https://newyork.cbslocal.com/2015/11/18/bionx-biom-prosthetic-ankle/ [https://perma.cc/2FGK-F9EM].
prosthetics will be hardwired into patients’ nerves and muscles, thereby merging flesh with computer code and hardware. The Department of Veterans Affairs Center for Innovation has also launched programs aimed at creating a series of open-source “smart” prosthetics for wounded veterans. Meanwhile, the Defense Advanced Research Projects Agency (DARPA) has been funding the development of next generation bionic arms, and DARPA’s Revolutionizing Prosthetics program successfully fitted a paralyzed woman with two nodes directly on her brain, allowing her to pilot a plane in a simulation. Recent research also demonstrated that with the help of an electrode array implanted in the brain, amputees will be able to move digits on a prosthesis with their thoughts alone, even without extensive training. To wit, a monkey recently


171. See Hawley, supra note 168 (“Carignan says his company wants to tie sensors into the existing muscles and nerves of the patient so they could have more active control over how the ankle works.”).


176. George Dvorsky, Brain Implant Will Let Amputees Move Individual Fingers on
controlled its wheelchair wirelessly using a brain implant and its thoughts,177 part of research toward the development of brain-controlled robotic exoskeletons for humans.178

Indeed, the potential health outcomes from these second-generation IoB technologies may be life-altering for many patients. For example, a brain implant currently in trials is expected to demonstrate the ability to restore sight to the blind,179 and a different brain implant has already helped a paralyzed man regain his sense of touch.180 Similarly, recent innovations in brain bypass181 technologies have allowed quadriplegics to operate their limbs with the assistance of brain-implanted microelectrodes, external machines, and a sleeve.182 A locked-in sufferer of Lou Gehrig’s disease has also successfully tested a brain implant of four sensor strips that wirelessly connected to a computer interface and allowed the patient to type out messages using her eyes and “brain clicks”183—the thought


183. Mariska J. Vansteensel et al., Fully Implanted Brain-Computer Interface in a Locked-
of “mov[ing] her hand for approximately 1 second.” Many promising second-generation IoB medical devices offer potentially transformational outcomes.

However, just as with first-generation IoB devices, while the earliest second-generation IoB devices have usually been classified as medical devices by the FDA, later second-generation IoB may include devices whose manufacturers may consider them to be “healthy lifestyle” and nonmedical devices. Indeed, the FDA considered most first-generation IoB devices to be nonmedical, and the FDA has flagged that a number of relevant guidance documents may evolve in the future because of the 21st Century Cures Act of December 2016. Meanwhile, technologically, the line between first-generation and second-generation IoB “healthy lifestyle”/nonmedical technology is already beginning to blur.

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184. Id. The machine activates whenever she thinks about moving her hand for about one second. Id.

185. For example, pacemakers fall into the most regulated category, Class III medical devices. Class III devices pose the greatest risk and, thus, are subject to a rigorous premarket approval (PMA) process. See Medtronic, Inc. v. Lohr, 518 U.S. 470, 476-77 (1996); 21 C.F.R. § 870.3680 (2012); 21 C.F.R. § 870.3710 (2011).

186. The FDA defines a device as follows: an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part, or accessory which is: 1. recognized in the official National Formulary, or the United States Pharmacopoeia, or any supplement to them, 2. intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, in man or other animals, or 3. intended to affect the structure or any function of the body of man or other animals, and which does not achieve its primary intended purposes through chemical action within or on the body of man or other animals and which does not achieve its primary intended purposes through chemical action within or on the body of man or other animals and which is not dependent upon being metabolized for the achievement of its primary intended purposes. The term “device” does not include software functions excluded pursuant to section 520(o).

187. GENERAL WELLNESS, supra note 96, at 2-5.

For example, a team of researchers in Australia is currently working on ingestible electronic capsules that monitor gas levels in the human intestinal tract to track variability driven by food consumption. Ingestible digital pills such as this one are likely to (attempt to) enter the market as a “healthy lifestyle” device. While medical uses are foreseeable, the FDA may also analyze this digital pill as primarily monitoring the effects of selective food consumption in healthy bodies. Therefore, much like a connected fitness tracker, this digital gas monitoring pill may fall outside the definition of a “medical device.” Consider also a swallowable “smart” vitamin absorption/sleep tracker that sends information about your body to your phone using Bluetooth, which then in turn uploads the information to the tracker company’s cloud. This IoB product would also potentially be deemed akin to a fitness tracker and, therefore, perhaps not necessarily classified as a medical device. As a consequence, it too may fall within the “healthy lifestyle” device categorization and outside the definition of a medical device. But some second-generation IoB devices will fall squarely outside either of these health-related categories and reflect selective, aesthetic human self-augmentation.


190. Id.

191. See id.

192. See GENERAL WELLNESS, supra note 96, at 3, 6-7. The FDA also does not currently review vitamin “supplements” for safety and effectiveness before they are marketed, instead relying on manufacturers to verify their safety. Dietary Supplements: What You Need to Know, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/food/dietarysupplements/usingdietarysupplements/ucm109760.htm [https://perma.cc/4RWC-RNDY].


195. Also consider the Circadia, an implantable device that allows for wellness tracking of “biomedical data and transmit[s] it to the Internet via Bluetooth.” Dom Benoseck, NIFTIT Partners with Grindhouse Wetware, NIFTIT BLOG (Dec. 3, 2013), niftit.com/niftit-grindhouse-wetware/ [https://perma.cc/KAY3-B3YM].
While occupational and recreational self-augmentation using second-generation IoB may seem the stuff of dystopian science fiction or merely the unusual hobby of (overly) enthusiastic computer scientists\(^{196}\) and controversial artists,\(^{197}\) this practice is, in reality, no longer limited to fiction and the social avant-garde.\(^{198}\) Indeed, estimates contend that approximately 50,000 to 100,000 people in the United States\(^{199}\) currently have microchips implanted in their bodies.\(^{200}\) Employers are encouraging their employees to chip themselves for convenience,\(^{201}\) repurposing technologies long used safely on animals.\(^{202}\) Chips can be used to store contact information for emergencies or Bitcoin wallet addresses,\(^{203}\) and chips can be custom programmed to, for example, place a phone call when tapped to a phone,\(^{204}\) open or lock a door,\(^{205}\) or buy a smoothie.\(^{206}\)

One company already sells a do-it-yourself implant kit for a few hundred dollars\(^{207}\) which allows for purchasers to modify their

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196. See infra Part II.B.
204. Grauer, supra note 200.
205. Farivar, supra note 203.
206. Associated Press, supra note 201.
207. CYBORGNEST, https://cyborgnest.net/ [https://perma.cc/3QP4-GKQC]. As of February
bodies in various Internet-connected ways, such as vibrating whenever the wearer is facing north. For example, one wearer uses an implant to inform her when a seismic movement occurs. Another wearer—the first legally recognized “cyborg” per his U.K. passport—fused his implant to his brain to have it translate color into musical tones. Informal “biohacking” communities and hackathons are increasingly popular, and formalized conferences and workshops already exist.

Also, as in every Internet context, marketing and “customer experience” data collection is pushing new technology adoption. Indeed, recent patent filings indicate this dynamic has already arrived to second-generation IoB. For example, British Airways has filed a patent with the UK Intellectual Property Office seeking to patent a swallowable “ingestible sensor” to monitor customer experience on flights from the inside of customers’ bodies.

In particular, as the preceding examples illustrate, one of the business dynamics visible in the evolution of second-generation IoB technologies is the merger of first and second-generation medical IoB with other existing consumer technologies, creating new recreational (nonmedical) IoB. For example, in medical contexts,


208. Generally two small titanium barbells akin to a piercing are implanted in the wearer’s chest. Id.
209. Id.
210. Id.
211. Id.
216. See id.
ocular lens implants have long been used as a surgical correction for eyes damaged by cataracts. Meanwhile, in recreational contexts, first-generation IoB gaming and other augmented reality devices initially involved glasses and other headgear, but then they started to include wearable IoB contact lenses. Blending these two technology trends—one from medicine and one from consumer and enterprise technology—it perhaps should be unsurprising that augmented reality and other recreational visual products are now creeping inside the eyeball in injected form. In other words, while these lenses were first used for medical reasons, they are now also used for recreational and military purposes. It is


221. For example, Google has patented an injectable implant that corrects and enhances vision and comes with an antenna for connecting to the Internet and recharging using special glasses. See Anthony Cuthbertson, *Google Patents a Cyborg Lens that Injects into Your Eye-ball*, NEWSWEEK (May 5, 2016, 5:14 AM), http://www.newsweek.com/google-patent-cyborg-smart-lens-jecteyeballs-455824 [https://perma.cc/7CMY-3SL5].


this progressive creep that will also transform current brain prosthetics into the third generation of IoB—where body and mind meld with the Internet and remote computing, not only for medical purposes but also as a chosen aesthetic enhancement.

3. Third-Generation IoB: Body Melded

Third-generation IoB devices meld the human mind with external computers and the Internet. As currently conceptualized, these devices primarily involve injected or implanted brain computer interfaces that act in a bidirectional read/write manner. In other words, they functionally extend and externalize portions of the human mind. Thus, one of the goals of third-generation IoB is the (optional) cognitive enhancement of healthy, able-bodied humans with the help of brain-implanted computers and linkages. As described by Elon Musk, the founder of a company researching ways to connect computers directly to brains, the goal is a “merger of biological intelligence and machine intelligence.”


226. See id.


231. Musk has voiced his concern that humans will be overtaken by artificial intelligence and turned into the metaphorical equivalent of a “house cat[.]” Solon, supra note 225; see also Sebastian Anthony, Humans Must Become Cyborgs to Survive, Says Elon Musk, ARS TECHNICA (Feb. 14, 2017, 8:50 AM), https://arstechnica.com/information-technology/2017/02/humans-must-become-cyborgs-to-survive-says-elon-musk/ [https://perma.cc/FU8D-9YN2].

232. Solon, supra note 225.
building these third-generation IoB devices sometimes call them a “direct cortical interface,” and they predict a coming “gold rush” in optional brain enhancement. Indeed, some financial analysts forecast a $27 billion market for these devices by 2023. Third-generation IoB devices are often not framed as a medical correction of a preexisting physical state.

Despite Musk’s recent assertions that third-generation IoB human testing will start in 2020, perhaps reassuringly, current third-generation IoB devices are generally believed to be in relatively early stages of development. While the goal of third-generation IoB includes brain enhancement and uploadable knowledge, their current uses are, in fact, primarily in the context of treating medical conditions. For example, brain prosthetic devices with wireless components are currently being tested and prescribed for humans with Alzheimer’s, Parkinson’s, epilepsy, and other conditions.


235. Id.

236. See id.


239. See Mark Molloy, Scientists Discover How to ‘Upload Knowledge to Your Brain,’ TELEGRAPH (Mar. 1, 2016, 7:45 PM), http://www.telegraph.co.uk/technology/2016/03/scientists-discover-how-to-upload-knowledge-to-your-brain/ [https://perma.cc/7MLG-QPVU].

240. See Ian Sample, Paraplegic Man Walks with Own Legs Again, GUARDIAN (Sept. 23, 2015, 8:00 PM), https://www.theguardian.com/science/2015/sep/24/paraplegic-man-walks-with-own-legs-again [https://perma.cc/PRA4-WKK6].


Another possible medical application entails helping soldiers recover from postwar memory loss and traumatic experiences. But slippage into nonmedical uses of third-generation IoB is already visible. For example, third-generation IoB research also assists in the creation of cognitively enhanced super-soldiers as part of the U.S. Armed Forces. As explained by DARPA Director Arati Prabhakar, “we can now see the future where we can free the brain from the limitations of the human body.... We can only imagine amazing good things and amazing potentially bad things that are on the other side of that door.”

Although we have not yet evolved an infrastructure and other technical capabilities that can successfully support the “brain-cloud” ideal of third-generation IoB, some experts estimate the arrival of third-generation IoB technology to be as little as a decade away. A decade may seem a long time to technologists, but in terms of legal evolution, this time frame signals a need for expedited debate and legal preparation.

While the potentially life-changing medical and lifestyle impact of a portion of these technologies is unquestionable, it is also the case that people will inevitably be hurt (and killed) by some of these technologies.

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244. See Matt Burgess, Scientists Use AI to ‘Rewrite’ Painful Memories in People’s Brains, WIRED (Nov. 21, 2016), http://www.wired.co.uk/article/brain-fear-decode-erase [https://perma.cc/5CDQ-PWE8].
245. The creation of super-soldiers is the alleged goal of a research program underway through DARPA. See Karla Lant, DARPA Is Planning to Hack the Human Brain to Let Us “Upload” Skills, FUTURISM (May 2, 2017), https://futurism.com/darpa-is-planning-to-hack-the-human-brain-to-let-us-upload-skills/ [https://perma.cc/4ZXS-XQEK].
246. Phillip, supra note 174.
247. See Houser, supra note 230 (“The company has to deal with the problems of biocompatibility, wirelessness, power, and ... bandwidth.”).
249. See Houser, supra note 230.
250. See id. (“The engineering is only half the battle, though. Like Musk mentioned, regulatory approval will be a big factor in the development and adoption of Neuralink’s tech.”).
IoB technologies. Consequently, impacted plaintiffs will seek recourse through the courts. In order to begin to craft a coherent and innovation-sensitive legal approach to address these IoB harms, let us first examine four lessons from our experiences with IoT.

B. The “Legacy Code” of IoT

Agent Smith: Never send a human to do a machine’s job.

As one Silicon Valley startup explains, the human body is “the next big innovation platform.” While this statement is accurate in heralding the arrival of IoB, it should also serve as a harbinger of looming harms and legal challenges. Because technology past is generally technology prologue, to anticipate the legal future of IoB, we can turn to an examination of the present state of IoT. Instructively, a series of serious IoT implementation problems have arisen as IoT has gained popularity. Parallel problems are already arising or are likely to arise in IoB.

Four of these IoT implementation problems include the “Better with Bacon” problem of gratuitous Internet connectivity, the “Magic Gadget” problem of failing to plan for failure, the “Builder Bias” problem of shipping without securing, and the “Mandatory Soup” problem of limited self-help, diminished market choice, and obsolescence through adhesion. However, when these four problems manifest in IoB contexts, they will present one critical difference from their IoT incarnation: human bodies may be directly physically harmed.
1. The Better with Bacon Problem: Gratuitous Internet Connectivity

An April Fools’ Day joke from 2013 touted the launch of the Toaster.io—a toaster connected to the Internet.\(^\text{260}\) At the time, the idea of a toaster being connected to the Internet seemed ridiculous to an average consumer.\(^\text{261}\) In hindsight, of course, the Internet of Things exploded shortly thereafter, and Toaster.io was merely a preview of actual products soon to arrive on the market.\(^\text{262}\)

The seemingly unrelenting “cybering” of all the consumer things\(^\text{263}\) that occurred in the IoT marketplace calls to mind an admonition from Professor Siva Vaidhyanathan. Professor Vaidhyanathan has argued that perfunctory innovation may be supplanting the idea of progress, stating that “[p]rogress is out-of-fashion.”\(^\text{264}\) He argued that “innovation differs from progress in many ways. Innovation lacks a normative claim of significant betterment. It emerges from many small moves ... [and] does not contain an implication of a grand path or a grand design of a knowable future.”\(^\text{265}\) Indeed, our model of “innovation” often appears to involve relentlessly connecting consumer products to the Internet, even when a product’s functionality is not necessarily materially enhanced by the Internet connectivity.\(^\text{266}\)

This argument lies at the heart of what might be called the “Better with Bacon” problem.\(^\text{267}\) Just as some restaurants seem to...
erroneously believe that all meals are “better” with an ample sprinkling of (sometimes unexpected) bacon, so too some technology producers and users believe that every gadget is “better” with gratuitous, even if functionally nonessential, Internet capabilities. While for some diners surprise bacon presents an unexpected benefit, for vegetarian diners, surprise bacon may effectively undermine the entirety of the enterprise. And, just as surprise bacon bits are never calorie-free (and sometimes unwelcome), gratuitous technology “bacon” is also never costless. It always comes at the expense of security.

While an Internet-connected toaster that, for example, emblazons the morning weather onto toast might seem like a harmless curiosity for a kitchen or corporate break room, its Internet connectivity adds attack surface and material risk for the security of a network as a whole. For example, a vulnerability in an IoT toaster may be an entree for compromising a company’s or a consumer’s otherwise protected network. Particularly in sensitive situations with national security or infrastructural implications, the IoT addition of Bluetooth devices. Bluetooth has been amply demonstrated to create additional vulnerabilities in systems. Chris Merriman, BlueBorne: Bluetooth Hack Doesn’t Require Pairing with Victims Devices, INQUIRER (Sept. 13, 2017), https://www.theinquirer.net/inquirer/news/3017247/new-bluetooth-hack-doesnt-require-pairing-with-victims-device [https://perma.cc/AE75-73QV].


269. An example of the phenomenon is the idea that all devices are better with Bluetooth. But see Merriman, supra note 267 (stating Bluetooth is a notoriously vulnerable technology).


whimsy-to-unreasonable security risk ratio should swiftly tilt the calculus in favor of choosing the non-IoT device.\textsuperscript{273}

Again, IoT history offers a warning: in 2013, the technology press and the security research community accurately predicted that ransomware\textsuperscript{274} would soon lock up computers at scale and that botnets would use IoT devices in denial of service attacks. Three years later, in 2016, a botnet of IoT devices committed a successful distributed denial of service attack against Twitter and Reddit, and entire hospital networks were crippled due to ransomware.\textsuperscript{275} Today, security professionals are already warning that gratuitously connecting human bodies to the Internet will end even more poorly— with botnets of bodyparts and human bodies immobilized by ransomware.\textsuperscript{277} Yet, despite these credible and somber warnings, our overenthusiasm and magical thinking leads us to often gratuitously and unwisely connect devices to the Internet without fully considering the additional security risk. This blind overenthusiasm also begets our next problem—the “Magic Gadget” problem.

2. The Magic Gadget Problem: Failing to Anticipate Failure

In his book \textit{Pinpoint}, author Greg Milner describes how, since the launch of the GPS system in 1980, humans have slid into over-reliance and magical thinking about the trustworthiness of the


\textsuperscript{275} See infra notes 288-90, 297, 321-23 and accompanying text.


\textsuperscript{277} One security professional has warned of IoB breast pumps being compromised and used as part of a denial of service attack. \textit{See} Alfredo Ortega (@ortegaalfredo), TWITTER (Jan. 5, 2017, 9:34 AM), https://twitter.com/ortegaalfredo/status/817031461878562816 [https://perma.cc/B6Y5-Y5SU] (“Botnets will get really weird this year.”); \textit{see also} Jeremiah Grossman (@jeremiahg), TWITTER (Oct. 19, 2016, 6:54 AM), https://twitter.com/jeremiahg/status/788739996739969024 [https://perma.cc/2XMC-S8JB] (“[B]ody implants are likely to be in our [near] future, so technically we’re personally going to be IoT devices.”).
technology.\textsuperscript{278} While GPS has generally eased the struggles of mapping, in some cases, it has contributed to the untimely demise of its users—what he terms “death by GPS.”\textsuperscript{279} As users blindly trust the “magic” gadget in their hand, they sometimes disregard other superior sources of evidence in physical space,\textsuperscript{280} even despite ample evidence that GPS can fail\textsuperscript{281} or be manipulated by attackers.\textsuperscript{282} This type of overly optimistic IoT thinking might be termed the “Magic Gadget” problem.

Turning to IoB, the adventures of Professor Mann offer a cautionary tale. Professor Steve Mann has experimented with IoB technology through an auto-recording augmented reality “glass eye” technology\textsuperscript{283} that is permanently attached to his head.\textsuperscript{284} In 2012, Mann’s IoB device was implicated in a physical altercation in a Paris restaurant.\textsuperscript{285} Allegedly, the restaurant employees decided to aggressively enforce a “no camera” policy and attempted to remove Professor Mann’s glass eye by force from his head.\textsuperscript{286} This unexpected physical disruption to Mann’s IoB device allegedly rendered it inoperable, partially due to a secondary, moisture-related,

\textsuperscript{278} See GREG MILNER, PINPOINT: HOW GPS IS CHANGING TECHNOLOGY, CULTURE, AND OUR MINDS 112-15 (2016).
\textsuperscript{279} Id.
\textsuperscript{280} See id.
\textsuperscript{284} See Edmiston, supra note 283.
\textsuperscript{285} See Katie Daubs, Toronto ‘Cyborg’ Steve Mann Says He Was Assaulted in Paris McDonald’s, STAR (July 18, 2012), https://www.thestar.com/news/gta/2012/07/18/toronto_cyborg_steve_mann_says_he_was_assaulted_in_paris_mcdonalds.html [https://perma.cc/5YD7-65WC] (noting that before the incident, another employee had accepted Mann as a customer, sold him food, and reviewed his doctor’s note).
\textsuperscript{286} See Edmiston, supra note 283.
hardware malfunction.\textsuperscript{287} Professor Mann's experience offers us a reminder that catastrophic IoB failures will often happen unexpectedly and that they are not always within our control.

Yet, technology over-trust and the Magic Gadget problem often cause a failure to plan for even catastrophic failures. Indeed, a harbinger of these looming Magic Gadget problems in IoB might be found in the March 2016 ransomware attack that crippled the network of a Maryland hospital chain, impairing the patient care in 10 hospitals and 250 clinics.\textsuperscript{288} With apparently no adequately robust crisis management system in place, employees described the attack as creating a “chaotic environment” and a “patient safety issue” that was potentially avoidable.\textsuperscript{289} The hospitals had allegedly failed to patch vulnerabilities (that were well-known in the security community since 2007) despite direct prior warnings and the existence of techniques exploiting those unpatched vulnerabilities.\textsuperscript{290} The Wannacry ransomware attack similarly paralyzed thousands of the U.K.’s National Health Service administrative computers,\textsuperscript{291} potentially contributing to physical harm of patients who were waiting on emergency surgeries and consultations.\textsuperscript{292}

But now consider a version of these ransomware scenarios in which the targeted devices are patients’ IoB artificial pancreases

\begin{itemize}
\item \textsuperscript{287} \textit{Id.} ("Like I said, I had to go to the washroom.... But when he pushed me out the door, at some point my pants became a toilet.... Some of the critical items were affected (by water damage.").
\item \textsuperscript{288} \textit{See John Woodrow Cox, MedStar Health Turns Away Patients After Likely Ransomware Cyberattack, WASH. POST (Mar. 29, 2016), https://www.washingtonpost.com/local/medstar-health-turns-away-patients-one-day-after-cyberattack-on-its-computers/2016/03/29/252626ae-f5bc-11e5-a3ce-f06b5ba21f33_story.html [https://perma.cc/E7P2-6JEU].
\item \textsuperscript{289} \textit{Id.}
\item \textsuperscript{290} \textit{See Sean Gallagher, Maryland Hospital: Ransomware Success Wasn’t IT Department’s Fault, ARS TECHNICA (Apr. 7, 2016, 10:12 AM), https://arstechnica.com/information-technology/2016/04/maryland-hospital-group-denies-ignored-warnings-allowed-ransomware-attack/ [https://perma.cc/5643-HNA9].
\item \textsuperscript{292} \textit{See Owen Hughes, WannaCry Impact on NHS Considerably Larger than Previously Suggested, DIGITALHEALTH (Oct. 27, 2017), https://www.digitalhealth.net/2017/10/wannacry-impact-on-nhs-considerably-larger-than-previuosly-suggested/[https://perma.cc/6Y8A-7A8Q] ("NHS England put the total number of cancelled appointments at some 19,494, which includes at least 139 patients who had 'an urgent referral for potential cancer cancelled.'").
\end{itemize}
instead of computer systems. Particularly, when we combine the Better with Bacon problem and the Magic Gadget problem with our next problem, the problem of Builder Bias, physical harm to IoB users becomes unfortunately entirely predictable and likely.  

3. The Builder Bias Problem: Shipping Without Securing

Consider the scenario in which a manufacturer with lax code-security practices has released a vulnerable IoB pancreas. The device’s rampant security vulnerabilities allow for a remote attacker to disable it, demanding a “ransom” payment to turn it back on. Or imagine a botnet comprised of injected IoB eye lenses that cannot be easily removed. How would an average consumer respond when he learns that his eyeballs might be implicated in a distributed denial of service attack on a critical infrastructure target?

As a wisely programmed computer once announced in the movie War Games, “[t]he only winning [strategy] is not to play.” The only viable answer to these IoB security failure scenarios lies in avoiding the problem from the outset—devices must be as secure as possible at the point of shipping. Yet, the lessons of IoT caution us that many builders of IoB will fail to build in line with what the FTC calls security by design. As builders rush to ship code to market, they often fail to prioritize the security and consumer safety of their code. IoT product manufacturers, in particular, have sometimes perceived themselves to have little financial incentive to prioritize security or to disclose and correct flaws, and security errors in their products have frequently gone undetected. For example, IoT


294. See WarGames (War Games) Quotes, ROTTEN TOMATOES, https://www.rottentomatoes.com/m/wargames/quotes/ [https://perma.cc/Y8S3-MMC2].


297. See id.

298. See id.
products are not always built to be updateable, and attempts to report flaws by third parties sometimes result in receiving legal threats instead of thanks. This failure of manufacturers to consider the implementation realities of security for fear it might delay shipping might be termed the problem of “Builder Bias.”

Historically, IoB devices—just like IoT devices—have also been notoriously vulnerable to attacks by third parties due to imprudent security design choices such as hardcoded passwords. In other words, the Builder Bias problem is already visible in IoB. For example, in 2012 when an episode of the television drama series Homeland included a plot twist where the sitting Vice President was murdered by a terrorist through a remote computer intrusion into his pacemaker, the possibility of such a compromise was already well-recognized within the security research community.

In other words, the knowledge that IoB pacemakers could be remotely compromised by attackers existed years before the recent FDA IoB security recall. Yet, despite this widespread knowledge, the medical device company that manufactured the pacemaker subject to the FDA security recall initially chose to deny the existence of a problem and to sue the security researcher who...


identified the flaw in its product. \footnote{See Charlie Osborne, MedSec Sued over St. Jude Pacemaker Vulnerability Report, ZDNET (Sept. 8, 2016, 8:30 AM), http://www.zdnet.com/article/medsec-sued-over-st-jude-pacemaker-vulnerability-report/ [https://perma.cc/FPF3-K38R].} Further, based on security research and warnings issued by the FDA\footnote{Cybersecurity, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/medicaldevices/digitalhealth/cybersecurity [https://perma.cc/WR6W-WZEU].} and the Department of Homeland Security, \footnote{See supra note 301.} we know that a “[v]ast array of medical devices [are] vulnerable to serious” attacks due to unpatched vulnerabilities and products that ship vulnerable by default. \footnote{See Dan Goodin, Vast Array of Medical Devices Vulnerable to Serious Hacks, Feds Warn, ARS TECHNICA (June 13, 2013, 4:54 PM), https://arstechnica.com/information-technology/2013/06/vast-array-of-medical-devices-vulnerable-to-serious-hacks-feds-warn/ [https://perma.cc/8BZP-3RX6].} Apart from the predicted concerns of ransomware disabling IoB devices in extortion schemes and botnets of body parts attacking third parties, \footnote{See supra notes 273-76 and accompanying text.} the Builder Bias problem in IoB has already manifested itself by introducing novel national security risks. For example, inadequate security on the website of an IoB fitness tracking application recently disclosed the location of a previously unknown military base through leaked information about the presence of large numbers of human bodies attached to IoB devices. \footnote{See supra note 301.}

Brain interfaces in second- and third-generation IoB, in particular, present opportunities for malicious actors to potentially compromise bodies in order to obtain confidential information, such as passwords, \footnote{See Richard Pérez-Peña & Matthew Rosenberg, Strava Fitness App Can Reveal Military Sites, Analysis Say, N.Y. TIMES (Jan. 29, 2018), https://www.nytimes.com/2018/01/29/world/middleeast/strava-heat-map.html [https://perma.cc/54TC-6YRR].} or—even more frighteningly—to corrupt the integrity or availability of the information residing in the brain hardware and, perhaps, even the functionality of the brain itself. Professor Jennifer Chandler and a team of coauthors raise concerns about the use of neuroprosthetic devices and the risk of “brainjacking”—the malicious manipulation of connected brain implants. \footnote{See supra note 301.} Similarly, Professors Tamara Bonaci, Ryan Calo, and Howard Jay Chizeck...
warn of the risk of “brain malware”\(^{313}\) and the need for an interdisciplinary approach to addressing the development of attacks on brain-computer interfaces.\(^{314}\) Through the eyes of a security professional, these compromised brains are not an “if,” they are a certainty—a “when.”\(^{315}\) While these concerns may still be a few years away; lessons from IoT security remind us that the pace and severity of attacks generally escalate and outstrip our preparedness to address them.\(^{316}\)

The three prior problems introduced above—the Better with Bacon problem of gratuitous connectivity, the Magic Gadget problem of the failure to anticipate failure, and the Builder Bias problem of shipping without securing—all converge to exacerbate the fourth problem—the problem of “Mandatory Soup.”

4. The Mandatory Soup Problem: Diminishing Market Choice and Obsolescence Through Adhesion

In the opening episode of _Battlestar Galactica_, a war rages in the galaxy.\(^{317}\) All of the most advanced military spaceships have been compromised by the enemy because they have been networked together and, therefore, are vulnerable to remote attack by the enemy.\(^{318}\) Only one ship remains viable—Galactica.\(^{319}\) It had been “airgapped”\(^{320}\)—intentionally kept off the grid and disconnected from

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316. George Dvorsky, _How Will We Stop Hackers from Invading Our Brains Once We’re Cyborgs?_, GIZMODO (June 29, 2017, 2:00 PM), https://gizmodo.com/how-will-we-stop-hackers-from-invading-our-brains-once-1796520628 [https://perma.cc/PUL8-PQY8].


319. Id.

320. See, e.g., Unknown Lamer, _Is Analog the Fix for Cyber Terrorism?_, SLASHDOT (Mar.
the other ships as an information security measure by its astute
captain, Adama.321 This plotline from a science fiction television
show teaches us an often neglected but basic lesson about techn-
ology: the mere existence of a newer technology does not automatic-
ically make that new technology the better choice for a particular
challenge.322 This principle that the most connected device may not
be the most appropriate device for a particular task might be termed
the “Adama Principle.”323

The Adama Principle is perhaps illustrated best by a famous IoB
pacemaker story from 2007 involving former Vice President Dick
Cheney. Six years before the compromised pacemaker episode on
Homeland324 aired, then-Vice President Dick Cheney was concern-
ed that attackers would attempt to compromise his implanted de-
fibrillator and kill him.325 As a consequence, he asked his doctor to
disable the device’s wireless functionality.326 But Cheney’s leverag-
ing of the Adama Principle is not the norm. Most consumers lack
the necessary information regarding potential vulnerability of IoB
to be able to make similarly informed choices about their bodies.327

Instead of the Adama Principle, what prevails in consumer mar-
kets is closer to what might be called the Mandatory Soup problem.
Consider a guest at a set-menu wedding dinner. As hardworking
servers distribute substantially identical meals to each diner, the
opportunity for customization is minimal. As a consequence, a diner
sometimes finds herself trapped behind a bowl of unwanted soup for

18, 2014, 12:01 AM), http://it.slashdot.org/story/14/03/18/021239/is-analog-the-fix-for-cyber-
terrorism [https://perma.cc/6CV9-FZJ3].
321. See Miniseries, Night 1, supra note 318. Captain Adama knew that the enemy—the
cylons—were masters at disabling battlestars by breaking into networks via wireless
networks and then using them to disable the whole ship and as a consequence, he ordered
that his ship never be networked. See id.
322. Michael C. Bodson, The Latest, Shiniest New Technology Isn’t Always the Best, WORLD
ECON. FORUM (Jan. 15, 2018), https://www.weforum.org/agenda/2018/01/why-the-latest-
shiniest-tech-isn’t-always-best/ [https://perma.cc/MPX7-4B7K].
323. For a different but related version of this idea, see Raza Panjwani (@occamsraza),
TWITTER (June 27, 2018, 7:40 AM), https://twitter.com/occamsraza/status/101198272611375
9232 [https://perma.cc/68D7-8GWV].
324. Chai, supra note 302.
[https://perma.cc/4G2Q-NUZK].
326. Id.
327. Horrigan, supra note 156.
a period of time. While other people may want the soup, she does not, and she experiences negative consequences because it has been foisted upon her. For example, the soup blocks her ability to use the plate beneath the bowl, and it inhibits her streamlined access to the wine in the middle of the table. It also places her at unnecessary risk of soup-related sartorial catastrophe.

The consumer marketplace is becoming flooded with a bevy of “Mandatory Soup” IoT products, often making less-connected versions of those same products nonexistent or hard to find.328 Rather than maximizing competition on degree of connectedness as a differentiating factor within individual product lines, we instead see a progressively impoverished marketplace with consumer products tending to default in their evolution to the maximum degree of connectedness.329 The Adama Principle of selecting the less connected option when appropriate becomes functionally impossible without extraordinary effort in this type of impoverished artificially constrained marketplace. For example, examining the new car market, finding a new car without multiple accompanying end user license agreements, always on location tracking, and several million lines of code is quickly becoming an impossible task.330

Indeed, not only is market choice becoming impoverished on the degree of product in connectedness, but the “real” price of competing goods with the same level of connectedness is becoming incomparable to an average consumer at the time of purchase. Material differences in future obsolescence and data stewardship are usually not disclosed at the time of purchase and not predictable for consumers.331 Thus, the actual cost of product ownership across time for consumers of an IoT device is frequently not accurately calculable

329. See id.
at the point of purchase.\textsuperscript{332} A consumer might choose away from one particular product knowing that the expected life is five years shorter than that of another (superficially) competitively priced product. Thus, the Mandatory Soup problem exposes consumers to the undisclosed price terms of (planned and unplanned) unilateral manufacturer obsolescence determinations and data handling changes—rights reserved in the terms of the accompanying (and evolving) end-user license agreements (EULA).\textsuperscript{333} This dynamic might be called “obsolescence through adhesion.”\textsuperscript{334}

IoT history again provides warnings about the hidden costs of Mandatory Soup and, in particular, obsolescence through adhesion. In 2014, Nest acquired an IoT start up called Revolv, a company that made a smart home hub intended to control devices such as lights, alarms, and doors.\textsuperscript{335} Allegedly because of an “allocat[ion] [of] resources,”\textsuperscript{336} Revolv announced that its service would shut down and customers’ applications would no longer work.\textsuperscript{337} In short, customers who had purchased the Revolv hub were informed, much to their surprise and dismay, that they would be left with a “bricked” device, regardless of what the company’s promises or customers’ reasonable expectations were at the time of purchase.\textsuperscript{338} This Revolv

\begin{footnotesize}
\begin{enumerate}
\item See id.
\item As such, it might be argued that in egregious cases, undisclosed hidden costs of planned obsolescence amount to an unfair trade practice under Section 5 of the Federal Trade Commission Act, warping competition in the marketplace of IoT products. \textit{A Brief Overview of the Federal Trade Commission’s Investigative and Law Enforcement Authority}, FED. TRADE COMM’N (July 2008), \url{https://www.ftc.gov/about-ftc/what-we-do/enforcement-authority} [\textup{https://perma.cc/44NZ-N37A}].
\item “Obsolescence through adhesion” refers to the combination of technical and contract-based measures in technology products that functionally hide the actual cost of ownership and can discretionarily force a consumer to discontinue use of a particular product, attempting to nudge the consumer into a new purchase. \textit{See Andrea Matwyshyn (@amatwyshyn), TWITTER} (Mar. 7, 2018, 10:39 AM), \url{https://twitter.com/amatwyshyn/status/971424989063925760} [\textup{https://perma.cc/52VP-YHX4}].
\item Id.
\item Alex Hern, \textit{Revolv Devices Bricked as Google’s Nest Shuts Down Smart Home Company}, GUARDIAN (Apr. 5, 2016, 5:04 AM), \url{https://www.theguardian.com/technology/2016/apr/05/revolv-devices-bricked-google-nest-smart-home} [\textup{https://perma.cc/CQN8-YL3G}].
\end{enumerate}
\end{footnotesize}
IoT incident highlights that consumers may not realize that IoT products are now functionally software products still tethered to the manufacturer through remote updates, despite their physicality.

Now, let us turn to the IoB context. Particularly when the obsolescence through adhesion dynamic relates to IoB security and future patches, consumers will find themselves in a dangerous lose-lose scenario that puts them at increased risk of physical harm. Imagine that your eyeball-injected IoB contact lens provider informs you that (per the terms of the contract on which you clicked “yes” when you downloaded your lens software), it has decided that it will no longer support the version of the software your lenses run and that it will no longer push out security patches for your eyes. None of your options are good in this scenario. You can get your lenses removed, risking physical harm and absorbing the cost. You can keep your lenses, knowing they are no longer supported, which, in turn, exposes you to different physical risks through malfunction or security compromise. Alternatively, you can buy “upgraded” lenses, absorbing those associated risks and costs. In all cases, the IoB manufacturer has contractually and technically forced an “upgrade” onto the body of the consumer.

While each of these four problems—the Better with Bacon problem, the Magic Gadget problem, the Builder Bias problem, and the Mandatory Soup problem—is independently a point of concern, when taken together in the context of some second- and third-generation IoB, the risks they present transform into a significant threat in the aggregate—the threat of physical harm to human bodies. Indeed, second-generation IoB presents obvious corporeal risks, while third-generation IoB presents the risk not only of losing control over our own bodies but also our cognitive processing. Put another way, third-generation IoB impacts our functional freedom of thought, and, as a consequence, it presents the threat of potentially losing control over the deliberative individual processes on which we implicitly rely not only for governance of our bodies but

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340. See id.
341. See supra Part I.A.2.
342. See supra Part I.A.3.
also for self-governance in a democratic society.\textsuperscript{343} In light of the gravity of these risks, let us consider the current state of IoT and IoB regulation and the desirable directions for its evolution.

C. The Future of Corporate Software Liability and IoB

\textit{Morpheus: What is real? How do you define ‘real’? If you’re talking about what you can feel, what you can smell, what you can taste and see, then ‘real’ is simply electrical signals interpreted by your brain.}\textsuperscript{344}

At present, third-generation IoB’s risks are (mostly) not yet upon us,\textsuperscript{345} but the challenges presented by second-generation IoB are already present and escalating.\textsuperscript{346} While last century’s legal approaches to technology were animated by a principle of avoiding the imposition of software liability in the name of innovation,\textsuperscript{347} IoB forces a recalibration of this default. As human bodies become regularly physically harmed by computer code, consumer and market trust in technology will wane without buttressed legal baselines of consumer protection.\textsuperscript{348} Indeed, recent survey data warns that this consumer trust breakdown is already in progress: growing numbers of consumers are doubting whether the Internet has been a mostly positive development for society.\textsuperscript{349}

Bolstering consumer trust in technology and constructing an innovation-sensitive legal framework for IoB begins with correcting the legacy problems of IoT identified in Part I.B—the residual deficits in consumer protection from IoT that are already transferring
into IoB. This correction requires improving consumer access to accurate information about the functionality, risks, and true costs of IoB products and services, as well as creating meaningful consumer recourse for physical harms occasioned by IoB. Evolution is needed, in particular, in the frameworks of certain regulatory agencies, tort, contract law, intellectual property, secured transactions, and bankruptcy.  

1. Regulatory Agencies

While first-generation IoB regulatory oversight has been primarily divided between the FDA and FTC, next generations of IoB will likely require a greater level of regulatory involvement not only from those two agencies, but also the Consumer Product Safety Commission, the Consumer Financial Protection Bureau, and the Federal Communications Commission, among others.

a. FDA

Although most first-generation IoB devices were deemed to fall outside the FDA’s definition of a medical device, a portion of second- and third-generation IoB devices will be deemed medical devices falling squarely within the FDA’s regulatory and oversight authority. With the goal of improving the quality of the software embedded in medical devices, including IoB medical devices, the FDA has released two guidance documents on security. The first is entitled “Content of Premarket Submissions for Management of Cybersecurity and Medical Devices: Guidance for Industry and Food and Drug Administration Staff,” dated October 2, 2014, and provides guidance on the types of security considerations medical device manufacturers should incorporate in developing (and disclosing substantiated information about) their devices, as

350. See Matwyshyn, supra note 339 (exploring questions regarding the IoB in the realms of regulatory agencies, intellectual property, contracts, and bankruptcy).
351. See id.
352. See supra note 96 and accompanying text.
353. See supra notes 183, 239 and accompanying text.
updated. The second guidance is entitled “Postmarket Management of Cybersecurity in Medical Devices: Guidance for Industry and Food and Drug Administration Staff” issued on December 28, 2016, and creates ongoing duties of care to ensure the security of devices on the market. These documents signal a shift in the agency toward greater scrutiny of IoB devices, particularly on security.

In addition to this guidance, at least three specific changes to the FDA’s current approach would materially improve its preparation for the further arrival of IoB. First, the FDA should compel significantly more detailed premarket disclosures from companies with respect to IoB technologies. These disclosures should include representations regarding third-party code audit and testing, specifying any embedded code libraries, third-party hardware components, and comparable information. In turn, the FDA should make this information available to the public and searchable. This additional information transparency will facilitate more informed decision-making by patients and medical professionals and allow for third-party researcher validation. The FDA should also continue to collaborate with the teams of security professionals that assisted it with its postmarket guidance to craft this list of necessary informational disclosures. For companies relying on the 510(k) premarket approval streamlined process to release devices, a duty of “security parity” should be required. Specifically, the FDA should

starting point for medical device manufacturers unfamiliar with the basics of security. See id. at 1-2. However, the guidance unfortunately does not provide rigorous disclosure requirements that would facilitate informed decision-making by consumers. See id. at 3-4. In particular, the guidance contains no discussion of third-party product audits or penetration testing of devices to assess the integrity, availability, and confidentiality of the code they contain. See id. at 4-5. Encryption of data is suggested only “where appropriate,” demonstrating a restrained set of recommendations that are unlikely to cause dramatic improvements in the quality of medical device security. See id. at 5.


357. U.S. FOOD & DRUG ADMIN., supra note 355.

358. See id. at 7.

359. See id. at 2.
issue guidance stating that by relying on the 510(k) process, these companies will be deemed to implicitly attest that their current devices (and all code therein) are as safe as their prior devices introduce no new risks to safety. This code safety warranty extends to security.

Second, the FDA should correct the imperfections in its adverse event reporting structures and improve the public accessibility of verified adverse event information. FDA adverse event reporting structures as they currently exist are not optimally suited to address security incidents in next generation technologies such as IoB.360 Despite the agency’s receptivity to third-party reports,361 there appears to be no obvious, publicized, formal channel through the website to accept adverse event reports from nonmedical professionals such as security researchers and others who have potentially identified the existence of life-threatening code flaws in medical devices.362 Similarly, past historical approval recall and adverse event data should be made more usable for patients. It should also be expanded and re-analyzed to provide more specific descriptions of incidents where a “software design issue” impacted the functionality of the medical device.

Third, the FDA should mandate as a condition of either a new device approval or a 510(k) premarket approval that it or a patient (or a deceased patient’s family or designee) be provided an opportunity to conduct an independent forensic analysis of an IoB device following an adverse incident. Manufacturers and insurers should be prohibited from exercising intellectual property and contract rights against patients to block the performance of forensic examinations of code in devices that potentially has led to human injury. Finally, the FDA should collaborate more formally and closely with the Federal Trade Commission to minimize potential regulatory gaps.

361. See id.
362. See id. (outlining voluntary reporting procedures for consumers and healthcare professionals, but not for nonmedical professionals). Recall information on medical devices with code flaws is also not easily findable for consumers who wish to determine the safety history of a particular medical device. See supra text accompanying notes 296-99.
As explained in prior sections, first-generation IoB devices were frequently deemed by the FDA to constitute general wellness and healthy lifestyle devices rather than medical devices. Consequently, their primary regulator became the FTC. With medical devices, the FTC’s enforcement is primarily limited to policing false, unfair, or deceptive health claims in advertisements and marketing. However, for lifestyle products such as most first-generation IoB devices including fitness trackers, the FTC is the primary enforcement agency not only for advertising/marketing, but also unfair and deceptive practices. In other words, whether the device is classified by the FDA as medical or “healthy lifestyle”/recreational directly impacts the FTC’s jurisdictional reach.

With second- and third-generation IoB devices, the FDA is again unlikely to decide that all of these devices are “medical devices,” particularly where the device’s stated primary use relates to optional self-augmentation for nonmedical reasons. Despite the FDA’s recent robust interest in security of medical devices, the FTC has historically taken the more aggressive posture in consumer protection and code quality, in particular with respect to data.
security and consumer privacy.\textsuperscript{370} For example, the FTC has engaged in approximately sixty enforcement actions to date\textsuperscript{371} against companies for failing to use reasonable security practices\textsuperscript{372} in their operations. Yet, the FTC is a much smaller agency than the FDA and currently lacks the bandwidth to monitor a future explosion of IoB devices (in addition to its current enforcement responsibilities) without additional resources.\textsuperscript{373}

The FDA and FTC have not formally collaborated up to this point on IoB issues. Formalizing this collaboration into a targeted, joint effort presents the most logical starting point for more effective regulation of second and third-generation IoB. Specifically, the FTC should launch a new “technology practices” group, with a joint FTC-FDA cross-detailed team focused on IoB enforcement.\textsuperscript{374} Because of the FDA’s and FTC’s distinct but complementary authority, this joint group would be able to engage in streamlined enforcement. Most importantly, the existence of the team and its coordination should prevent IoB products that harm consumers from falling through the definitional gaps of what does and does not constitute a “medical device.” In particular, the new IoB team in the technology practices group should be granted rulemaking and fining authority by Congress,\textsuperscript{375} and it should also use core FTC Act Section 5 authority to aggressively enforce the FTC Act’s prohibition on

\begin{footnotesize}
\textsuperscript{372} See START WITH SECURITY, supra note 295.
\textsuperscript{374} This team should include cross-detailed investigators, technologists, and attorneys whose enforcement activity will focus on both the marketing practices and technological risks of IoB devices.
\textsuperscript{375} While the FTC could create this practice group using its current regulatory authority under Section 5 of the FTC Act and its other statutory authorities, a congressional authorization explicitly granting fining and rulemaking authority to a new practice group would nudge the group’s creating with greater speed and agency confidence.
\end{footnotesize}
unfair and deceptive advertising claims about IoB. In particular, with respect to “lifestyle” and recreational IoB, ensuring disclosure of the hidden consumer costs identified in earlier sections of this Article aligns with the FTC’s mission of consumer protection and preserving fair competition in the market. Thus, the new technology practices group would both protect consumers from unfair and deceptive practices and encourage fair competition—the two cornerstones of the FTC’s mission.

c. CPSC

The Consumer Product Safety Commission (CPSC) offers an underexplored avenue of consumer protection in IoT and IoB. Any IoT device, such as a smart TV or an Internet-connected baby monitor, is also subject to any applicable safety requirements of CPSC. However, the CPSC has only recently begun an inquiry regarding the safety of Internet of Things products and has otherwise not yet engaged with rulemaking in the areas of embedded device hardware and software safety in any IoB-specific context. Consequently, the CPSC should organize a working group around issues of IoB hardware and software safety, culminating in

378. See What We Do, supra note 365.
379. See id.
rulemaking that focuses on IoB consumer products.\textsuperscript{384} It should also contribute a cross-detailed team to the FTC’s new technology practices group.

d. CFPB

As companies experiment with “social credit” monitoring,\textsuperscript{385} it is perhaps predictable that the current wide breadth of (sometimes inaccurate)\textsuperscript{386} information included in U.S. credit reports and background checks will continue to expand. In particular, assessments of credit “risk” based on streams of data from IoB devices are likely to become incorporated. For these reasons, the Consumer Financial Protection Bureau’s (CFPB) self-interpretation of its mission\textsuperscript{387} and its express regulatory authorization\textsuperscript{388} (as well as the definition of “credit report”\textsuperscript{389}) should be extended to include all potentially “credit-impacting information,” regardless of the identity of the corporate holder and not merely the historical categories of information held by traditional credit reporting agencies and financial institutions. With this expansion, the CFPB would be well-positioned to engage in enforcement actions where IoB data streams, particularly streams from second- and third-generation

\textsuperscript{384} For a discussion of the CPSC, see Anita Bernstein, \textit{Implied Reverse Preemption}, 74 BROOK. L. REV. 669, 669 (2009).

\textsuperscript{385} For example, China uses a social credit score system. \textit{See, e.g.}, Mara Hvistendahl, \textit{Inside China’s Vast New Experiment in Social Ranking}, WIRED (Dec. 14, 2017, 6:00 AM), https://www.wired.com/story/age-of-social-credit/ [https://perma.cc/ZSD8-ZGQW].


\textsuperscript{387} The CFPB describes its mission as follows: “The CFPB implements and enforces federal consumer financial laws to ensure that all consumers have access to markets for consumer financial products and services that are fair, transparent, and competitive.” \textit{Rulemaking}, U.S. CONSUMER FIN. PROT. BUREAU, https://www.consumerfinance.gov/policy-compliance/rulemaking/ [https://perma.cc/C6PJ-JWUK].

\textsuperscript{388} The Dodd-Frank Act created the CFPB, setting forth its mission as follows: “The Bureau shall seek to implement and, where applicable, enforce Federal consumer financial law consistently for the purpose of ensuring that all consumers have access to markets for consumer financial products and services and that markets for consumer financial products and services are fair, transparent, and competitive.” 12 U.S.C. § 5511(a) (2012).

IoB, impact the financial opportunities of consumers because of data repurposing and licensing.

e. FCC

Perhaps surprisingly, the Federal Communications Commission’s (FCC) and Congress’s ongoing net neutrality debate is important to IoB’s future. If consumers rely on life-enabling or hard-wired IoB technologies, poor Internet connectivity will have physical consequences. Consider the next generation of neural-bypass technologies—technologies already FDA approved for testing—that allow paralyzed limbs to function with the assistance of a body-external computer and a chip implanted in the body. These technologies will rely on software for their security and functionality, and all software requires patching and updating. This means that at least some aspects of operation of these IoB devices are likely to rely on real-time Internet access and feedback. Poor Internet access will, therefore, potentially mean increased risk of physical harm and limited functionality for these IoB bodies.

The reasons for poor connectivity may be due to inadequate network infrastructure, but they may also be due to deliberate throttling decisions by an Internet provider for “network management” purposes or because the customer (the IoB company or the consumer) have purchased a lower “tier” of service. Serious

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394. See supra notes 166-76 and accompanying text.
395. See supra Introduction.
396. See, e.g., supra notes 16-20 and accompanying text.
397. See, e.g., Urban, supra note 241.
physical security consequences are possible, particularly in security emergencies. For example, imagine the WannaCry attack scenario, but instead of hospital administrative computers, the malware exploits an unpatched vulnerability in IoB medical devices. Imagine an emergency patch becomes available, but it is too large to push to some users because of the bandwidth limitations of their tier of Internet service. Unpatched, vulnerable code in an Internet of Bodies device means that an attacker may be able to take control of or harm the connected body part through that device.

For reasons of security, a robust market in Internet of Bodies products will not blossom without reliable and abundant, high-quality (and affordable) Internet access. These Internet infrastructure and market conditions are a prerequisite for the functionality, security, and adoption of IoB devices.

In addition to these regulatory questions, IoB security failures and data breaches will lead to additional regulatory consequences under existing data protection statutes on the federal, state, and international levels. But, there are also less obvious legal and security questions involving tort, contract, intellectual property, and secured transactions and bankruptcy law.

2. Tort

In what might be considered a type of technology performance art, a technology writer recently connected a shock-delivering IoB bracelet he was wearing to Twitter and informed his followers that

399. See id.
400. For a discussion of the importance of reliable and redundant Internet access to the adoption of IoB, see Matwyshyn, supra note 393.
401. Id.
they had the ability to zap him remotely.\textsuperscript{404} Although the product in question, an IoB bracelet that pairs with mobile phones and intentionally shocks the wearer, was presumably not designed with third-party Internet zapping in mind, the company’s CEO appeared to validate this particular personalization and other repurposed uses.\textsuperscript{405} The writer’s experiment and the CEO’s response raise interesting, unsettled questions regarding the relationship among code, tort, security, and IoB product testing and design. In the situation where a device, such as this one, malfunctions and causes bodily injury, courts will struggle with fact-intensive legal inquiries in IoB.

As Professor Mark Geistfeld has explained in the IoT context of connected cars:

\begin{quote}
The potential for legal error is ... compounded by the need for courts to resolve this issue for each body of state tort law. As compared to a relatively “easy” problem, courts across the country are more likely to adopt different rules for solving a difficult tort issue, creating substantial variability within the national market.\textsuperscript{406}
\end{quote}

A similar dynamic is likely to present itself in the context of IoB.

Indeed, journalists have long warned that current medical devices regularly demonstrate lack of care in their manufacture and testing upon closer examination.\textsuperscript{407} These concerns become amplified in the context of IoB. In addition to the software-interrupted surgery discussed in Part I and the medical disruptions caused by

\begin{footnotesize}
\begin{enumerate}
\item See \textit{id.} (“I think the public experiment is very cool, and we LOVE the ability to “touch” across the Internet—including vibration patterns, sound, and zap,” Maneesh Sethi wrote over email. ‘Of course, it’s all configurable to what you want.’”).
\item Mark A. Geistfeld, \textit{A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation}, 105 CALIF. L. REV. 1611, 1618-19 (2017). Professor Geistfeld further explains that courts “will presumably correct mistakes over time, but the prospect of initial legal error and widespread disagreement creates an additional source of uncertainty for manufacturers trying to assess their potential liability in the national market.” \textit{Id.} at 1619.
\item See \textit{Are Implanted Medical Devices Creating a 'Danger Within Us'?}, NPR (Jan. 17, 2018, 3:10 PM), https://www.npr.org/2018/01/17/578562873/are-implanted-medical-devices-creating-a-danger-within-us [https://perma.cc/9P6Q-CQXA].
\end{enumerate}
\end{footnotesize}
ransomware in Part II, software errors have already been implicated in deadly medical failures.\textsuperscript{408} However, the nonmedical uses of IoB are also likely to sometimes result in unfortunate outcomes with bodily injury. The regulatory gaps described previously\textsuperscript{409} mean that some IoB products will potentially be subject to no preemptive regulatory scrutiny before entering the market. This legal environment also makes it more likely that plaintiffs will turn to tort law to address the failures in these products that cause physical harms to human bodies.

Because, to date, a majority of IoT consumer harms have related to privacy and security,\textsuperscript{410} private litigants have faced challenges in demonstrating actual economic losses in the eyes of some courts.\textsuperscript{411} However, the obstacles of demonstrating actual economic loss become substantially more straightforward when the connected “thing” is a human body: the “blue screen of death”\textsuperscript{412} can become, quite literally, a blue screen of death or the cause of extreme physical harm for an IoB-connected human. In other words, the economic loss will often be more easily quantifiable and economically demonstrable in IoB contexts than was possible in prior generations of software cases. Because of courts’ familiarity with providing recourse for bodily injury in tort, these IoB cases are likely to result in new doctrinal lines of software liability.

Instead, the tort arguments are likely to shift toward various possible calculations of damages amounts and to what extent any liability protection exists for the device manufacturers—akin to traditional medical device harm cases.\textsuperscript{413} These determinations will

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409. See supra text accompanying notes 345-49.


413. Manufacturers may also attempt to identify the cause of the harm as a deficit of care
examine whether the devices are “medical” in the eyes of the FDA, the relationship of contract waivers of liability, what constitutes defective design, and the well-trodden debates in tort law over the appropriate calculations of pain and suffering. The often predictable failures of code and hardware visible in the Internet of Things will morph into the often unpredictable and idiosyncratic failures of devices and software intersecting with various idiosyncrasies of the “hardware” of human bodies.

Specifically, suits seeking recourse for harms arising from IoB will encounter the “legacy code” of tort law—doctrines of product liability and its subfield of medical device liability in particular. Some will succeed even in the IoB medical device context tort liability is likely in some cases. Historically, courts have not uniformly protected manufacturers from tort liability in health device cases, particularly for devices that are not deemed to be Class III medical devices.414 For IoB manufacturers, a lower FDA class categorization for their medical IoB device may seem attractive because it means getting to market faster. However, that lower categorization may also mean greater risk of tort liability, including for security harms.415

The case law litigating disputes around pacemakers and cochlear implants, two of the earliest IoB devices,416 may act as a harbinger of how we might expect tort claims for IoB harms to play out in the courts. Tort claims for pacemaker harms have generally involved eight kinds of claims: failure to warn,417 breach of warranty,418

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414. See, e.g., Paul H. Sunshine, The Preemptive Scope of the Medical Device Amendments of 1976, 50 FOOD & DRUG L.J. 191, 209 n.135 (1995) (“A determination that a device belongs in class III, as opposed to classes I or II, completely shields the manufacturer of such device from state tort liability. Courts generally have been deferential to FDA reclassifications.”).

415. See id.

416. Pacemakers and cochlear implants are now calibrated while attached to the body by physicians through the use of software. See, e.g., Jeff Lagasse, Cochlear Limited Launches FDA-Cleared, Apple-Compatible Cochlear Implant, MOBIHEALTHNEWS, https://www.mobihealthnews.com/content/cochlear-limited-launches-fda-cleared-apple-compatible-cochlear-implant [https://perma.cc/M6EN-3ZXX].

417. See, e.g., Lohr v. Medtronic, Inc., 56 F.3d 1335, 1350-52 (11th Cir. 1995) (holding that the plaintiffs’ failure to warn claim was preempted).

418. See, e.g., Talbott v. C.R. Bard, Inc., 63 F.3d 25, 31 (1st Cir. 1995) (holding plaintiffs’ breach of warranty claim was preempted).
design defect, negligence, fraud, misrepresentation, RICO, and unfair state trade practices. Cases demonstrate that courts are not always quick to dismiss, and some claims for failure to warn and breach of warranty have resulted in plaintiff success. One material obstacle for plaintiffs is the possible preemption of their claims by federal law under the Medical Device Amendments to the Food, Drug, and Cosmetic Act; however, courts have ruled both in favor of federal preemption and against preemption in pacemaker cases. Cardiac pacemakers have also been held to be unavoidably unsafe products within the meaning of comment k to Section 402A of the Second Restatement of Torts, which adds to plaintiffs’ difficulty in establishing claims. Yet, this determination has not dispositively prevented recovery in all

419. Lohr, 56 F.3d at 1347.
420. Id.
421. See, e.g., Woods v. Gliatech, Inc., 218 F. Supp. 2d 802, 810-11 (W.D. Va. 2002) (holding that the Medical Device Amendments did not preempt the plaintiff’s negligence, fraud, and failure to warn claims against the manufacturer of a device used in surgical back procedures).
423. See, e.g., In re Cordis Corp. Pacemaker Prod. Liab. Litig., No. MDL 850, C-3-86-543, 1992 WL 754061, at *3 (S.D. Ohio Dec. 23, 1992); see also Int’l Bhd. of Teamsters v. Philip Morris, Inc., 196 F.3d 818, 823 (7th Cir. 1999) (“[G]etting a product that causes deferred injury and medical expenses, causes a loss of one’s money, which is ‘property.’”).
425. See, e.g., Woods, 218 F. Supp. 2d at 810-11 (holding that the Medical Device Amendments did not preempt the plaintiff’s failure to warn claims against the manufacturer of a device used in surgical back procedures).
426. See, e.g., Fogal v. Steinfeld, 620 N.Y.S.2d 875, 883 (Sup. Ct. 1994) (ruling defective design, breach of warranty, and failure to warn claims against pacemaker manufacturer were not preempted).
428. §§ 301-399.
430. See, e.g., Medtronic, Inc. v. Lohr, 518 U.S. 470, 502 (1996) (holding that the FDA’s shortened approval process for devices that are substantially similar to those already on the market does not trigger preemption of state common law claims under section 360k(a)—the Medical Device Amendments’ preemption provision).
431. RESTATEMENT (SECOND) OF TORTS § 402A cmt. k (AM. LAW INST. 1965) (“There are some products which, in the present state of human knowledge, are quite incapable of being made safe for their intended and ordinary use.... Such a product, properly prepared, and accompanied by proper directions and warning, is not defective, nor is it unreasonably dangerous.”) (emphasis omitted).
cases.\textsuperscript{432} Cochlear implants cases have similarly resulted in rulings divided on the preemption issue,\textsuperscript{433} with some claims in negligence,\textsuperscript{434} breach of warranty,\textsuperscript{435} fraud and negligent misrepresentation,\textsuperscript{436} and common law strict liability surviving preemption analysis. Therefore, it is fair to say that courts have not adopted a uniform position on pacemaker and cochlear implant manufacturer liability in tort and that the inquiries are particularly fact-intensive.

IoB device cases are likely to further feed this doctrinal complexity in tort cases, leading to years of uncertainty in IoB tort litigation. While this result may seem inefficient, it is not necessarily a bad outcome. By contrast, if courts took a legal shortcut and adopted a position that the mere presence of software should dispositively trigger liability limitation, the consequences would be undesirable for IoB consumer protection. Meanwhile, the inverse, in an unnuanced form, might damage IoB medical innovation.

3. Contract

Professor Margaret Radin has argued that contract law, particularly through the use of boilerplate terms, has facilitated the convergence of machine and text, leading to an undesirable imbalance that places consumers at risk in their technology transactions.\textsuperscript{438} The contract law imbalances that Professor Radin has highlighted become exacerbated when the technologies at issue are attached to and embedded in human bodies with IoB.

\textsuperscript{432} See, e.g., \textit{Lohr}, 518 U.S. at 494 (holding that plaintiff’s negligent design claims under Florida law were not preempted).


\textsuperscript{434} See, e.g., \textit{id.} at *2 (refraining from even considering if negligence claim was preempted).

\textsuperscript{435} See, e.g., \textit{id.} at *2-5.

\textsuperscript{436} See, e.g., \textit{id.} at *2 (refraining from even considering if fraud claim was preempted).

\textsuperscript{437} See, e.g., \textit{id.} at *2-5.

\textsuperscript{438} \textsc{Margaret Radin}, \textit{Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law} 9, 15-18 (2013) (arguing that normative and democratic degradation is resulting from the standardization dynamics in current digital contracting); see Margaret Jane Radin, \textit{Online Standardization and the Integration of Text and Machine}, 70 \textit{Fordham L. Rev.} 1125, 1125 (2002) (arguing that “blurring is helping to break down the distinction between technological standards and legal standards”).
IoB companies primarily rely on contracts—such as EULA and privacy policies—to obtain the rights to monitor, aggregate, and share users’ body data, as well as to retain rights in the software. Learning again from IoT history, we find a collision of contract law from sales of physical goods, on the one hand, with norms of the world of software contracts, on the other.439

Traditionally, under the approach set forth in the individual state versions of Uniform Commercial Code (UCC) Article 2, when purchasing a physical good, a consumer usually retains certain rights of recourse regardless of what any agreement accompanying the physical good may stipulate.440 New products are generally not sold on an as-is/where-is basis.441 However, historically, that minimum guaranteed level of functionality/fitness, merchantability, and consumer recourse has not been the default with respect to software products.442 Indeed, most end-user license agreements stipulate that the code is provided as-is/where-is and that consumer remedies, including any remedies under UCC Article 2, do not apply.443 IoT has added complexity not only with respect to consent in contract

439. This crash will particularly impact warranties implied by law and recourse/enforceability of limitations of liability.

440. See, e.g., U.C.C. § 2-315 (AM. LAW INST. & NAT’L CONFERENCE OF COMM’RS ON UNIF. STATE LAWS 2017) (“Implied Warranty: Fitness for Particular Purpose. Where the seller at the time of contracting has reason to know any particular purpose for which the goods are required and that the buyer is relying on the seller’s skill or judgment to select or furnish suitable goods, there is, unless excluded or modified under the next section an implied warranty that the goods shall be fit for such purpose.”).

441. For a discussion of implied warranties, see, for example, Stacy-Ann Elvy, Hybrid Transactions and the INTERNET of Things: Goods, Services, or Software?, 74 WASH. & LEE L. REV. 77, 87 (2017) (arguing that “[t]he application of Article 2, along with its implied warranties to transactions involving IOT products, may encourage IOT companies to effectively address ... security concerns.”); Matwyshyn, supra note 330, at 1183 (arguing for implied warranties of security modeled on UCC Article 2 and landlord-tenant law).

442. For a discussion of software liability see, for example, Peter A. Alces & Aaron S. Book, When Y2K Causes “Economic Loss” to “Other Property,” 84 MINN. L. REV. 1, 5 (1999) (assessing “[w]hether the strict products liability law provides the basis to award a commercial entity damages for the ‘economic loss’ caused by the Millennium Bug”).

443. For example, the EULA for one of Ford’s software products embedded in cars includes extensive limitations of liability and disclaimers of warranties and imposes an “obligation to drive responsibly” on drivers. FORD, END USER LICENSE AGREEMENT, https://www.ford.com/resources/ford/general/pdf/sync3eulareformatted.pdf [https://perma.cc/B472-C4VX].
formation, but also with respect to breach and damages analysis. Similarly, IoT has also caused us, yet again, to engage with many of the issues discussed decades ago during the debate over the drafting of UCC Article 2B for software transactions. But, now these questions also directly implicate aspects of the functionality in the context of a UCC Article 2 consumer good. It also wades us knee-deep into the doctrinal weaknesses of the \textit{ProCD, Inc. v. Zeidenberg} line of cases.

Despite the practical reality that users rarely read or comprehend lengthy user contracts (even Chief Justice John Roberts has admitted to not always reading them), courts have been slow to limit their enforceability. Meanwhile, companies’ aggressive contracting practices raise progressively more troubling questions. For

\begin{itemize}
  \item For a discussion of consent in IoT, see, for example, Scott R. Peppet, \textit{Regulating the Internet of Things: First Steps Toward Managing Discrimination, Privacy, Security, and Consent}, 93 Tex. L. Rev. 85, 95 (2014).
  \item See, e.g., Stacy-Ann Elvy, \textit{Contracting in the Age of the Internet of Things: Article 2 of the UCC and Beyond}, 44 Hofstra L. Rev. 839, 864 (2016) (discussing IoT, robotic agents, and that “a principal may be subject to liability to the agent for breach of contract”).
  \item Elvy, supra note 441, at 148 (arguing that viewing IoT transactions as hybrid “could present insurmountable problems of proof in determining how to apply different rules of damages”). Courts look at a number of factors in determining the severity of breaches, including the extent to which money can make the plaintiff whole. See Elvy, supra note 445, at 864 (discussing the complexity of IoT device breach of contract).
  \item UCC Article 2B became the Uniform Computer Information Transactions Act (UCITA) and the Uniform Electronic Transactions Act (UETA); UCITA was adopted in only two states, but UETA was widely adopted. See generally Richard E. Speidel, \textit{Revising UCC Article 2: A View from the Trenches}, 52 Hastings L.J. 607 (2001). For a discussion of the UCC Article 2B revision process, see id. at 607 (explaining that there “was plenty of trouble in the Article 2 process”).
  \item 86 F.3d 1447 (7th Cir. 1996).
  \item In particular, courts have not yet grappled with the question of “returnability” or rejection of nonconforming or defective software when it has been embedded into the ecosystem of your body and potentially caused harm. For a discussion of the shortcomings of \textit{ProCD}, see, for example, Andrea M. Matwyshyn, \textit{Technoconsent(s)}, 85 Wash. U. L. Rev. 529, 550-54 (2007).
\end{itemize}
example, some IoT companies have allegedly threatened to deactivate or “brick” devices unless a consumer assents to contract changes relating to data privacy and information sharing. In IoB contexts, that potentially bricked device may be embedded in a body, and may control physical functionality of that body. In such cases, judges are likely to struggle with denying recourse to harmed plaintiffs, at least in equity if not in contract.

Doctrinal approaches to addressing these harms may hinge upon a reinvigoration of formation doctrines around voidability of agreements for formation defects such as coercion/duress and undue influence, as well as strengthening the enforcement doctrines around procedurally and substantively unconscionable terms. However, IoT and IoB contracting contexts impact not only state contract law but also “contract-adjacent,” product-specific state consumer protections laws, as well as the practical impact of state data breach notification laws. These state-specific consumer protection regimes present an accessible starting point for buttressing consumer protection. States can strengthen disclosure obligations not only around the occurrence of data breaches but also pre-breach at point of product purchase, in particular creating implied warranties of


454. For a discussion of equity first principles, see C.C. Langdell, A Brief Survey of Equity Jurisdiction, 1 HARV. L. REV. 355, 358 (1888).

455. See Matwyshyn, supra note 449, at 554-55, 554 n.119.

456. Andrea M. Matwyshyn, Data Devolution: Corporate Information Security, Consumers, and the Future of Regulation, 84 CHI.-KENT L. REV. 713, 727 (2010) (“In addition to the FTC Act, many states have consumer fraud laws, known as the “Little FTC Acts,” that often authorize private citizens to recover damages and attorney fees for loss resulting from the merchant’s deceptive practice. The remedies under state and local consumer fraud laws are often stronger than those under similar federal statutes; they also apply to more seller practices than do federal laws.”).

security and privacy in every EULA, and statutorily deeming of certain types of consumer recourse and liability to be nonwaivable.

b. Criminal Law and the Third-Party Doctrine

Questions of the relationship between IoB EULAs and the human body become particularly critical in criminal law contexts. Again, prosecutorial use of the third-party doctrine and IoT data streams present an instructive model. But the direct interaction of IoB and criminal contexts has also already begun: a recent criminal prosecution for insurance fraud expressly relied on IoB-derived evidence. The case illustrates one aspect of the doctrinal and constitutional questions under the Fourth and Fifth Amendments involving IoB: in 2017, in an Ohio prosecution of a defendant accused of aggravated arson, the court admitted IoB pacemaker data obtained from the defendant’s pacemaker company. This case also serves as a reminder that the Supreme Court has already identified the need for evolution of the third-party doctrine in light of the changing nature of technology.

Thus, complex questions lie at the intersection of consensual IoB data sharing and criminal law. Is the data cocreated by the defendant’s body? Is an IoB device that simply extrudes a feed of physical evidence akin to a fingerprint that can be compelled by police

458. For a discussion of the potential effectiveness of implied warranties of security and privacy in state contract law, see, for example, Matwyshyn, supra note 330, at 1183 & n.495.
462. Judge Rules Pacemaker Data Admissible in Court, supra note 461. The defendant faced aggravated arson charges. Id. He claimed that “he was woken by a fire at home, packed a case, broke a window and threw out the bag. A cardiologist told police his explanation was ‘highly improbable’ based on his heart rate and cardiac rhythms at the time.” Id.
without constitutional concerns? Or, perhaps, this live data feed is better considered testimonial evidence subject to a higher level of judicial scrutiny, particularly if the IoB device in question is a third-generation IoB device directly connected to a human brain (and, therefore, raising obvious freedom of thought-autonomy concerns)? Is the real-time location acquisition of the IoB device akin to location data collected from a tracking device attached to the underside of a suspect’s car or historical cell-site location? These questions of criminal law will be more thoroughly addressed in a subsequent article.

4. Intellectual Property

Perhaps one of the most formidable and undertheorized obstacles to IoB consumer protection will arise with respect to enforcement of intellectual property rights by third parties in second- and third-generation IoB bodies.

a. Patent

The Internet of Bodies sets up a collision between users’ physical security/bodily integrity on the one hand and patent law on the other. Indeed, the current wave of software patent litigation is unlikely to spare IoB devices. In particular, patent assertion entities are likely to begin eyeing IoB patents for acquisition.

465. Id. at 371-75.
468. See Jeanne C. Fromer, The Compatibility of Patent Law and the Internet, 78 FORDHAM L. REV. 2783, 2783 (2010) (“[H]ow, if at all, patent law and the Internet’s values are compatible is undertheorized.”).
469. Indeed, a portion of Internet of Bodies patents will likely end up in the portfolios of patent assertion entities—follow-on owners of patents sometimes known as “patent trolls” that make a business out of maximal patent-rights enforcement. See Mark A. Lemley & A. Douglas Melamed, Missing the Forest for the Trolls, 113 COLUM. L. REV. 2117, 2118-20 (2013).
470. IoB patents potentially provide greater leverage for patent assertion entities to extract settlements out of alleged infringers, as the public relations consequences and consumer trust outcomes might be more negative for the alleged infringer than in a usual technology
For example, consider second-generation IoB such as an eyeball-injectable, “smart” contact lens, a concept already patented by major technology companies.  Imagine that an injected contact lens maker is sued by a patent assertion entity alleging that the code that operates the lens infringes a patent it holds. While some IoB manufacturer defendants might be able to afford to settle, many would not; neither could they afford protracted litigation. But even assuming the defendant litigates, a court may decide that the technology is infringing, in which case, the manufacturer may not be allowed to—or financially able to—continue providing its services. Consumers with the allegedly infringing lens already injected into their eyeballs would lose twice in this scenario: once because they purchased and injected the lenses (in reliance upon a now discontinued service) and a second time because their eyes now have injected lenses in them that no longer function (which means that the consumer faces costs and physical risks of lens removal). Unlike any other recreational products implicated by patent judgments that consumers might have previously experienced, an infringing second- or third-generation IoB device will involve potentially removing hardware from the inside of their bodies.

Indeed, IoB patent questions will intersect with doctrinally complex “legacy” questions in patent law, and preservation of bodily security and autonomy may present the next frontier for patent law reform. IoB will catalyze the need for resolution of prior open questions in patent law, in particular the deeply uncertain legal status of software patentability (despite multiple attempts at clarification) and the patentability of follow-on discoveries from patent situation. See id. at 2126-27.

471. See supra notes 217-24 and accompanying text.


473. For a discussion of software patentability see, for example, Lemley & Melamed, supra note 469, at 2119-20 (explaining that although patent trolls “now [are] a majority of all patent assertions in the country and ... win both larger judgments and larger settlements than do ... [firms] that practice patents ... despite complaints that they often assert weak patents,” there are also more complex patent dynamics at work); Greg R. Vetter, Patent Law’s
human bodies. Yet, the extent to which intellectual property holders should hold sole control over the disposition of an IoB device once implanted in a body is relatively new territory for courts. A harbinger for concern is again visible in IoT contexts, where courts have sometimes sided with patent holders, forcing companies to disable allegedly infringing functionality. If courts analyze IoB patents in similar ways, they will increasingly be forced to choose whether to cause the bricking of body parts or brain functionality, to direct the specific performance of invasive surgery to remove allegedly infringing intellectual property from IoB bodies, or, instead, to construct some sort of approach that acts as a compulsory patent licensing regime for IoB devices.

The most aggressive courts might even consider some IoB consumers to constitute patent infringers themselves. As Professor Gaia Bernstein warns, consumer “[e]nd users are likely to become even more prevalent in patent litigation” and they are “at a significant disadvantage in patent disputes,” particularly when patent assertion entities are influencing the patent landscape. Meanwhile, Professors Julie Cohen and Mark Lemley warn that patent law might be used as a sword not only in stopping infringing use but also potentially in stopping reverse engineering, a process that will frequently be used to assess IoB safety by both security experts and consumers.

Unpredictability Doctrine and the Software Arts, 76 MO. L. REV. 763, 766-67 (2011) (arguing that “the progression of software technology since the time of the precedent influencing enablement for software patents suggests a failure by the law to recognize the changes in the technology”).


In particular, the history of medical procedure patent litigation provides a cautionary tale of how patent litigation might harm the security and autonomy of IoB bodies. In the 1990s, a doctor was sued by a patent holder for performing an allegedly infringing but medically necessary procedure on a patient. After public outcry, in 1997, Congress statutorily limited the ability of medical procedure patent holders to recover patent damages related to a medical practitioner’s performance of a medical activity. Similar congressional intervention may lie in the Internet of Bodies’ future, rebalancing patent rights and bodily security.

b. Copyright

In contrast to patent law, legal debates around IoT and security have already crafted a new balance between consumer protection of IoB bodies and copyright. In 2015, the Copyright Office and Librarian of Congress granted an exemption to Section 1201 of the Digital Millennium Copyright Act (DMCA) that expressly allows security analysis of code in IoT devices and, consequently, IoB devices. As long as this exemption continues to remain in effect (or, preferably, if Congress follows the suggestion of the Copyright Office and amends the DMCA to make the exemption permanent) most consumer protection research on IoB devices will not face dispositive obstacles from copyright. Yet, these policy battles have

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482. The exemption stipulates that those devices must not be, for example, already attached to a human body and not in operation. Id. at 65956. Therefore, some analysis of IoB devices may fall outside the protected scope of DMCA security research conduct. See id.

483. The Copyright Office has encouraged Congress to amend the DMCA and adopt a permanent version of this exemption. U.S. COPYRIGHT OFFICE, SECTION 1201 OF TITLE 17, 73-74 (June 2017), https://www.copyright.gov/policy/1201/section-1201-full-report.pdf [https://perma.cc/29SE-DLLL].

484. Until the granting of this exemption, however, merely testing the functionality of code
also demonstrated that medical device companies and other manufacturers of IoT and IoB products have traditionally taken an aggressively copyright-maximalist stance. 485 However, presuming that the DMCA Section 1201 security research issue is at least temporarily addressed, the primary remaining copyright issue pertains to the copyrightability of databases of personally identifiable information extracted from IoB devices.

The extent of copyrightability of databases has presented division in the legal scholarship. 486 Professor James Boyle has argued that “in copyright law—to a greater extent than in most other fields of legal doctrine—there is a routine and acknowledged breakdown of the simplifying assumptions of the discourse, so that mundane issues force lawyers, judges, and policymakers to return to first principles.” 487 Indeed, the challenges IoB introduce will force a return to a first principles analysis, particularly with respect to questions of database copyright and body-internal data streams. 488

Professor Boyle also argues that by disaggregating an idea from its expression, it becomes possible—at least in theory—to both give

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486. For a discussion of the debate over copyrightability of databases, see, for example, Daniel J. Gervais, The Protection of Databases, 82 CHI.-KENT L. REV. 1109, 1157 (2007) (“[S]ome forms of restriction sought by database owners almost as knee-jerk attachment to ‘property’ may not, in the end, be in their own interest.”); James Gibson, Re-Reifying Data, 80 NOTRE DAME L. REV. 163, 167 (2004) (“The most controversial aspect of the pro-expansionists’ reaction to the digital dilemma, however, has been a combination of the technological and the legislative—an approach one might call ‘technological,’ as it involves the legislative regulation of technological behavior in the market for information goods.”); Jacqueline Lipton, Balancing Private Rights and Public Policies: Reconceptualizing Property in Databases, 18 BERKELEY TECH. L.J. 773, 775-82 (2003) (arguing that creating private property rights in databases will not inevitably lead to commercial and social problems).


488. See id.
the idea to the public while offering rights over the expression to the writer. Yet, when the “writer” in question is your Internet-connected pancreas mediated by software written by a third party, courts will perceive themselves to be faced with hard choices in the attribution of rights in the databases created from IoB streams of extracted data, as well as rights in the information from their subsequent analysis. In the context of IoB, the issues are further complicated through the interaction with the law of secured transactions and bankruptcy. However, as a starting point, judicial determinations of copyright impacting IoB should follow the model of the Copyright Office in the granting of the DMCA consumer products security research exemption: they should consider consumer protection concerns as a counterweight to maximalist copyright interpretation. These topics, along with their corollary issues from secured transactions and bankruptcy, are the subject for a companion essay to this Article.

5. Secured Transactions and Bankruptcy

Imagine the situation where a bankruptcy court debates the sale of contract rights and databases in the bankruptcy estate of, for example, the company that provided your IoB injected contact lenses or your brain prosthetic device. There would be no shortage of prospective purchasers for these assets. For example, insurance providers might be interested in purchasing IoB contract rights in order to monitor consumer behavior in real time to better predict...

489. Id. at 18-19.
490. See id.
491. As Professor Boyle has argued, “[t]o say that a particular advantage may not be exploited in one area does not commit us to the view that it may not be exploited in another.” Id. at 85.
492. For a company without many physical assets, the most valuable asset that the company would offer in bankruptcy to satisfy its creditors would be its contractual relationships with its users and its extensive database of personally identifiable consumer information. See Katherine J. Clayton, Comment, Liquidating a Technology Company in Bankruptcy, 4 N.C. J.L. & TECH. 169, 170-71 (2002). Although various consumers will have implemented dramatically different preferences with respect to privacy settings, a court is unlikely to be interested in interpreting privacy preferences with that degree of granularity. See supra notes 122-53 and accompanying text.

bankruptcies, agency resource constraints mean that FTC intervention will not be possible in every IoB situation. Indeed, these concerns with IoB bankruptcies have already begun. For example, a first-generation IoB fitness company recently filed for liquidation of its assets.

A first step toward recalibrating this balance in bankruptcy involves amending the definitions of UCC Article 9 to expressly exclude databases of raw IoB-collected data from their scope. A second step may include amending the responsibilities of the bankruptcy trustee, charging the trustee with weighing consumer protection concerns on par with those of secured creditors, and essentially creating the equivalent of an automatically perfecting “phantom” security interest for consumers in their IoB information. Consequently, the privacy ombudsman and the FTC become merely a check and balance on the bankruptcy trustee in the handling of consumer protection, rather than the primary method of consumer protection intervention. A third step might involve amending the Bankruptcy Act to require explicit reaffirmation of consumer consent to each transfer of functional control over IoB contract rights with a consumer right to termination that includes information deletion and discontinuation of body tracking.


501. See supra note 373 and accompanying text.


503. For a discussion of Article 9’s scope, see, for example, Xuan-Thao N. Nguyen, Collateralizing Privacy, 78 TUL. L. REV. 553, 574-77 (2004).

504. The idea of a phantom interest arises from the securities context. For a discussion of phantom interests, see, for example, Note, Phantom Stock Plans, 76 HARV. L. REV. 619, 619, 622-23 (1963).

505. The idea of automatic perfection is not novel. Secured transactions law addresses purchase-money security interests in consumer goods in this manner. By removing the filing requirement, the consumer’s interests can be protected without imposing any logistical burden on consumers. For a discussion of PMSI, see, for example, Alan M. Christenfeld & Aleksandra Kopec, Purchase-Money Security Interests, 41 U.C.C. L.J. 291, 292-94 (2009).

506. Professor Xuan-Thai Nguyen has argued in favor of altering the regime of financing statements. Nguyen, supra note 503, at 585-87.

507. Peppet, supra note 444, at 160-64.
While each of these proposed regulatory and legal approaches will construct a more trusted set of consumer baselines for second-generation IoB, the legal challenges presented by third-generation IoB run deeper. They force us to revisit the unsettled questions of an individual’s interests in her own body and the deeper question of whether the human body is a construct to be preserved or replaced in an age of technological innovation.

II. KANTIAN HEAUTONY

Neo: Why do my eyes hurt?
Morpheus: You’ve never used them before.508

The prior Parts introduced IoB and explained how legacy problems from IoT threaten the confidentiality, integrity, and availability of human bodies.509 However, the basic legal inquiry of the extent to which a person is entitled to an inalienable legal default of control over her own body underpins their legal analysis. In other words, while the technologies of IoB are new, questions of control over the human body are not new to legal scholarship and jurists. Nevertheless, in a world of IoB, our traditional propertized debates over body “ownership” and, more importantly, the underlying framework of Kantian autonomy will no longer cleanly fit the technical realities shaping our legal conversations. As concrete physical harms to human bodies and minds caused by IoB begin to emerge, this mismatch of past legal discourse with the reality of harm will become obvious, particularly in our discussions of the desirability and regulation of third-generation IoB.

A. Why Autonomy Fails with IoB

In an iconic article setting forth the dominant analytic paradigms for the human body, Professor/Judge Guido Calabresi asked a seemingly simple question: do we own our bodies?510 As his scholarly discussion unfolded, Calabresi took his readers on an

508. THE MATRIX, supra note 2.
509. See supra Part I.B.
intellectual journey using this question of body “ownership” to highlight the existence of four distinct analytical approaches used by legal scholars—doctrinalism, functionalism, legal process, and law and status—and posited how each would answer the question of whether humans own their own bodies.  

Calabresi offers a valuable articulation of body “ownership” interests that particular scholars are likely to consider—autonomy, insights from other disciplines, institutional capacity, and exploitation risks. Yet, his underlying question of body “ownership” assumes a legal inquiry framed through the lens of property law. This underlying assumption is worthy of reexamination.

1. Owned Bodies Versus Pwned Bodies

Professor Radhika Rao explains that case law frames “property” as a “bundle of rights.” “The ‘bundle of rights’ which has been associated with property includes the rights to possess, to use, to exclude, to profit, and to dispose.” Yet, none of these rights exist in the traditional sense in a second- and third-generation IoB body.

Subject to a license agreement in connection with the code inside an IoB device, a user of an IoB device may never fully “possess” the device. The right to use the device is contingent for its user, subject to unilateral alteration or degradation choices by a remote third party—the obsolescence by adhesion dynamic discussed in Section I.B. As explained in the prior discussion of hidden price terms, use may be arbitrarily terminated in the discretion of the device manufacturer in many cases. Exclusion is similarly not entirely possible: manufacturers of IoB devices view the data stream arising from the device as potentially the most lucrative source of revenue

511. Id. at 2132-33, 2137, 2144, 2146.
512. Id. at 2132-33, 2137, 2144, 2146-47.
513. Id. at 2151.
516. Id. at 405-06 (quoting Brotherton v. Cleveland, 923 F.2d 447, 481 (6th Cir. 1991)).
518. For a recent controversy, see Whittaker, supra note 452.
520. For example, Professor Devin Desai has previously examined the tensions between
and will harvest it as long as the device is in use, regardless of the desires of the user.\textsuperscript{521} Through repackaging and selling (access to) this information to “trusted partners” (whose identities are rarely disclosed to the human attached to the IoB device), exclusion of others by the consumer is functionally impossible as long as the IoB device is in use.\textsuperscript{522} Similarly, if the device is a medically prescribed IoB device such as a pacemaker, discontinuation of use is not a real option. Most consumers are not Vice President Cheney—they lack the bargaining power to demand alteration of technical functionality.\textsuperscript{523}

Disposition presents a similar problem: once the information streams generated by the IoB device are collected, the manufacturer has no incentive to dispose of them, and the IoB user cannot legally demand that the collected data be deleted under current U.S. law in almost all cases.\textsuperscript{524} Further, the legal status of these data streams is unclear as a protectable user interest.\textsuperscript{525} Even in purely physical body disposition situations, scholars highlight that the common law has always been divided and contradictory.\textsuperscript{526} Indeed, as Professor Kara Swanson has explained, particularly on the point of finding property interests in body products such as blood, eggs, and semen, courts have demonstrated confusion and have been inconsistent in their findings.\textsuperscript{527} Partially due to this doctrinal confusion, the Supreme Court tends to frame discussions of the body in ways that consciously avoid the body-propertization conversation.\textsuperscript{528}

\textsuperscript{521} For a discussion of data valuation from a corporate perspective, see, for example, Andrea M. Matwyshyn, \textit{Privacy, the Hacker Way}, 87 S. CAL. L. REV. 1, 22-23 (2013).

\textsuperscript{522} Desai, supra note 520, at 179-80.


\textsuperscript{524} See Matwyshyn, supra note 521, at 2-3.

\textsuperscript{525} See id.

\textsuperscript{526} Rao, supra note 515, at 405-09.


\textsuperscript{528} See Moore v. Regents of the Univ. of Cal., 793 P.2d 479, 487-89 (Cal. 1990).
But perhaps the most fundamental incompatibility between a world of IoB bodies and property frameworks arises because of security issues. Property paradigms assume the knowability of the bundle of rights and risks that are being traded and that those bundles can be meaningfully constrained through the legal act of alienation or license. The security realities of IoB devices render this knowability functionally impossible—a third-party attacker may stealthily usurp both parties’ control over an IoB device. Further, IoB security issues will always simultaneously be public safety and public health issues as well as private interests. The problem of “reciprocal security vulnerability”—the fact that private and public security concerns are inextricably entwined—again renders property paradigms a poor fit for IoB bodies.

But why then are so many legal scholars drawn to this suboptimally fitting intellectual frame of property law? The answer may lie in part in their search for the strongest possible doctrinal hook for notions of bodily autonomy. Indeed, an analysis of IoB’s impact on autonomy yields yet another layer of concerns for freedom of thought, freedom of speech, and the future of deliberative democracy.

2. Autonomy Versus Heautonomy

As explained by Professor Robert Merges, “[p]roperty theorists identify autonomy as perhaps the chief value inculcated by

erally SWANSON, supra note 527.
529. See supra Part I.B.3.
530. Rao, supra note 515, at 405-06.
531. See supra Part I.B.3.
532. For a discussion of the problem of reciprocal security vulnerability, see Matwyshyn, supra note 330, at 1121-25.
533. As explained by Professor Margaret Radin, Conservatives rely on an absolute conception of property as sacred to personal autonomy. Communitarians believe that changing conceptions of property reflect and shape the changing nature of persons and communities. Welfare rights liberals find entitlement to a minimal level of resources necessary to the dignity of persons even when the entitlement must curtail the property rights of others. Margaret Jane Radin, Property and Personhood, 34 STAN. L. REV. 957, 957-58 (1982). Another reason may arise in their falling victim to the “economic value fatalism” which asserts that in order to protect something, one must propertize it. Matwyshyn, supra note 521, at 14-15.
individual ownership rights.” This concept of autonomy is often framed in reference to the work of Immanuel Kant. Legal scholars often define Kantian notions of autonomy in reliance on his work in 

Groundwork of The Metaphysics of Morals and Kant’s frame in the first two Critiques—the Critique of Pure Reason and Critique of Practical Reason. In Metaphysic of Ethics, Kant explains that “the concept of freedom is the key that explains the autonomy of the will.” With this direct textual connection to a discussion of governance and notions of freedom, legal and philosophical scholarship has understandably focused heavily on Kantian autonomy and how it intersects with law. This Kantian notion of autonomy has permeated not only property law but legal scholarship generally.

Pierre Bourdieu and other noted scholars have amply critiqued Kant’s work, and legal scholars have framed the Kantian person as “simply an abstract autonomous entity capable of holding rights, a device for abstracting universal principles and hence by definition devoid of individuating characteristics.” However, when exploring Kant’s later writings and the corresponding explanatory work of

539. IMMANUEL KANT, CRITIQUE OF PRACTICAL REASON 29-32 (Werner S. Pluhar trans., Hackett Publ’g Co., Inc. ed. 2002) (1788).
540. Kant, supra note 537, at 94. Kant continues,

Will is a kind of causality belonging to living beings in so far as they are rational, and freedom would be this property of such causality that it can be efficient, independently on foreign causes determining it; just as physical necessity is the property that the causality of all irrational beings has of being determined to activity by the influence of foreign causes.

Id.
541. For a discussion of Kant’s vision of the relationship of morality to law, see generally George P. Fletcher, Law and Morality: A Kantian Perspective, 87 COLUM. L. REV. 533 (1987).
542. Kantian autonomy has also been an animating argument of First Amendment scholarship. For a discussion of First Amendment scholarship on Kantian autonomy, see generally Christina E. Wells, Reinvigorating Autonomy: Freedom and Responsibility in the Supreme Court’s First Amendment Jurisprudence, 32 HARV. C.R.-C.L. L. REV. 159 (1997).
544. Radin, supra note 533, at 971.
philosophers, the theoretical underpinnings of Kantian autonomy become more complex than many legal scholars might perhaps expect.

Kant’s framing of the precedent conditions for autonomy help to highlight the overarching legal and democratic concerns introduced by IoB. Specifically, the key precedent condition for Kantian autonomy is what Kant calls heautonomy. Heautonomy has been unexplored by legal scholars in the law review literature. The Third Critique of Judgment, where the term appears, may appear initially to offer a less apposite text for law than his other work as it addressed the process of “common sense” judgment of the aesthetic and teleology. Nevertheless, it is here in the Third Critique that Kant offers a more complex picture of autonomy’s prerequisites. And for purposes of an analysis of IoB, because Kant clearly intended this discussion of heautonomy to impact analyses of both “aesthetics and teleology” specifically, the concept is particularly well-suited. As prior Parts have argued, IoB is not only medical; it also includes voluntary technological self-augmentations done for aesthetic reasons. For these reasons, the concerns embodied in Kantian heautonomy offer an important warning and a good fit for a legal critique of IoB.

545. The reason for this deficit of exploration may arise from philosophy’s more limited engagement with the source of the discussion—Kant’s Third Critique of Judgement. Kant’s Third Critique of Judgment has been extensively referenced in art criticism theory despite its comparatively less popular status in legal and philosophy circles. See, e.g., Diarmuid Costello, Greenberg’s Kant and the Fate of Aesthetics in Contemporary Art Theory, 65 J. AESTHETICS & ART CRITICISM 217, 221, 225-26 (2007).

546. A search in Westlaw on heautonomy yields four results—an introduction to a symposium and three articles written by philosophers. Westlaw Search for Heautonomy, WESTLAW, https://1.next.westlaw.com [https://perma.cc/RG6-REV4] (typing “heautonomy” in search bar, then pressing the search button). Based on these results, it appears no legal scholar has ever engaged deeply with the philosophical construct of heautonomy. See id.


548. Id.
549. See id.
550. Id. at 195.
551. See discussion of Professor Mann, supra Part I.B.2.
552. As the introductory material on one IoB self-augmentation website describes it, “[t]he reason is simple. Adding more senses will make you smarter and result in a richer life experience.” The North Sense, CYBORGNEST, https://cyborgnest.net [https://perma.cc/9CZD-4A7B].
In his introduction to the Third Critique of Judgment, Kant explains the critical nature of the distinction between autonomy and heautonomy: “The Judgment has therefore also in itself a principle a priori of the possibility of nature, but only in a subjective aspect; by which it prescribes, not to nature (autonomy), but to itself (heautonomy) a law for its reflection upon nature.” The distinction between Kantian autonomy and Kantian heautonomy has been described thus—autonomy refers to “acting freely according to one’s form,” but in contrast, heautonomy refers to “being the source of the form according to which one acts ... literally self-self-governing.” While autonomy is the third-party viewable manifestation of freedom, heautonomy is the internal manifestation of freedom—the capacity of reflective judgment and self-self-governance, uncorrupted by involuntary inputs and unsurveilled. Heautonomy is the “self-applicability of judgment’s a priori principle.” It is this process of heautonomy which, for Kant, underpins any externally visible exercise of freedom through subsequent autonomy. In other words, it might be said that for Kant, autonomy is the intersection of the human in context of the rest of the world, while heautonomy is the internal ability of the human to process inputs and set the rules over the self in preparation for these autonomous interactions—a private deliberation. Heautonomy is thus an independent process that occurs in a metaphorical hermetically sealed self, free from pushed influence of third parties. Autonomy exercise follows, contingent upon the outcomes of these heautonomous

554. Lydia L. Moland, Friedrich Schiller, STAN. ENCYCLOPEDIA OF PHIL. (Apr. 2017), https://plato.stanford.edu/entries/schiller/ [https://perma.cc/LMC9-Y9CL]. Schiller also uses the term “heautonomy,” but uses it to describe the regulative character of aesthetic, not teleological judgment, which materially differs from Kant’s usage. Sabine Roehr, Freedom and Autonomy in Schiller, 64 J. HIST. IDEAS 120, 120 (2003) (“What is perfect can possess autonomy, in so far as its form is determined purely through its concept; but only beauty possesses heautonomy, because only in beauty is the form determined by the inner nature.” (footnote omitted)).
555. Moland, supra note 554.
556. See id.
557. Floyd, supra note 547, at 195.
558. Some philosophy scholars have noted that heautonomy might have been a good model for what Kant initially calls autonomy. PAUL GUYER, KANT 173 (2006).
559. KANT, supra note 553.
560. Id.
561. See id.
Consequently, heautonomy is a necessary precursor to any successful exercise of autonomy.563 Kant’s underlying model for his discussion of heautonomy has been analyzed by philosophers to be “a legal one.”564 Thus, applying the lens of Kantian heautonomy crystallizes that the greatest threat presented by some second- and, in particular, third-generation IoB: the undermining of a human’s ability for self-self-governance and, consequently, the undermining of the implicit prerequisites of deliberative democracy. In the world where third parties have a live feed into your senses and your brain, the possibility of truly detached, deliberative internal processes begins to disappear. Every thought and involuntary action could become a “broadcast” by our bodies, sometimes to our detriment. But even more importantly, in a world where we know that IoB devices will end up regularly compromised, the human’s own body—as controlled by a remote third-party attacker—may undermine the very inputs and processing upon which heautonomy relies. In other words, some second and third-generation IoB—brain prosthetics and digital cortex interfaces, in particular—create the opportunity (and likely the inevitability) of third-party attacker corruption of human bodies and minds. Consider, for example, a data breach of third-generation IoB devices—a literal brain dump with sensitive information that could victimize impacted consumers on a new level of severity. When we build technologies that allow for owning and pwnning565 of (parts of)

562. See id.
563. See id.
564. One of the most thorough philosophy analyses of heautonomy is offered by Professor Juliet Floyd. Floyd explains that Kant calls this capacity for reflexive judgment “facultas diiudicandi” and that Kant claims that the capacity to exercise it is really the same as the capacity for making adjudications … of cases in terms of rules. A judge is obliged to render a verdict by applying the rule(s) of law to a particular case. And whenever alternative, conflicting rulings seem plausible, a (good) judge does not make a determination “mechanically” for it is not (good) enough simply to quote the law. An argument must be given … whether the case does or does not fall under the auspice of a given rule. In difficult (legal) cases, deliberation is required in order that a determination be made in a non-arbitrary manner…. As Kant writes, by means of the exercise of reflective judgment we “make the universal concept specific by indicating the diversity that falls under it, just as teachers of law … talk about the specification of certain raw material.” Floyd, supra note 547, at 199.
565. See supra note 513.
human bodies—regardless of whether those rights of access are controlled by the public or the private sector—we risk undermining the process of “self-self-governance” that Kant highlighted as essential to autonomy and freedom.566

In this way, third-generation IoB, in particular, has the potential to corrupt the security not only of our bodies and our minds but also the security of the social structures of governance upon which democratic institutions rely. These heautonomous processes have always been the “secret sauce” for enabling robust First Amendment debate and deliberative democratic process. Thus, IoB introduces the technological viability of functionally damaging or perhaps even eliminating what Professor Neil Richards has called “intellectual privacy”567 and what First Amendment theorists consider to fall within protections for a necessary freedom of thought.568 In a world where our bodies and minds are connected to a single interconnected technological network, we begin to blur the lines between the freedom of thought, i.e. the physiological and heautonomous event of having a thought internally, and the act of broadcasting curated thoughts through the freedom of speech, i.e. the external autonomous manifestation that follows (or doesn’t follow) a thought. This is the distinction between heautonomy and autonomy that IoB potentially threatens.569 For these reasons, our animating legal principle for IoB should reflect a focus on creating legal structures capable of safeguarding heautonomy and the freedoms that emanate from it.

These legal and ethical choices about the commodifiability, disposition, and disposability of IoB bodies and their impact on

566. Moland, supra note 554.
569. For example, notions of contractual and informed medical consent are already straining as currently implemented. See, e.g., Radhika Rao, Informed Consent, Body Property, and Self-Sovereignty, 44 J. L. MED. & ETHICS 437, 438 (2016) (arguing that the “true challenge of informed consent is that this venerable doctrine often functions as a charade, a collective fiction which thinly masks the uncomfortable fact that the subjects of human research are not actually afforded full information”).
he autonomy force us to ask a deeply uncomfortable question about our legal baseline assumption: Is the human body an existential construct to be protected and preserved or is it merely an outdated “operating system” or “platform” awaiting an “upgrade” from new technologies? Our answer to this question regarding the value of the human body as a construct will dispositively influence our IoB legal frameworks across areas of law. Therefore, for better or worse, legal scholars and policymakers must confront this somewhat forbidding (and foreboding) question.

B. Humanity—Bug or Feature?

Morpheus: Throughout human history, we have been dependent on machines to survive. Fate, it seems, is not without a sense of irony. At a recent conference, Professor Judith Rauhofer commented with a thought-provoking question: Will the Internet of Bodies really move society toward communities of autonomous, free-thinking cyborgs? Or, instead, asked Professor Rauhofer, will IoB result in the slow decline of humanity into The Borg? Much like Professor Rauhofer’s question, the preceding Parts of this Article leave open a set of significant, unanswered, and uncomfortable social and legal questions. Perhaps the most basic of these open questions asks, “if the technological and legal changes that IoB will introduce are so transformational, does that impact the baselines of what we view as a ‘correct’ human?” The perhaps unsettling answer is that indeed it may.

While both my own prior scholarship and the work of other scholars have considered some aspects of human-machine

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571. Id.
572. THE MATRIX, supra note 2.
573. CPDPConferences, CPDP 2018: The Internet of (Vulnerable) Bodies, YOUTUBE (Feb. 6, 2018), https://youtu.be/1ORlk8uj-lo?t=32m0s [https://perma.cc/F8HP-9ASB].
574. Id.
575. I have argued that. See Andrea M. Matwyshyn, Corporate Cyborgs and Technology Risks, 11 MINN. J.L. SCI. & TECH. 573, 573 (2010).
576. Id.
577. For example, Professor Paul Schwartz has called for a ban on data trade through the use of implantable chips, arguing that “[t]he privacy consequences of implantable chips will
convergence and its regulatory impact, the law review literature has done so in only a limited manner to date.\textsuperscript{578} We currently lack a robust legal framework within which to consider social transformations, technological drift, and the human body.

Although the first generation of IoB has only sporadically tested our social norms of “acceptable” and “desirable” optional self-augmentation, nonmedical second- and third-generation IoB will likely do so with uncomfortable regularity. These body-internal and body-melded IoB devices will catalyze a need to craft a shared legal vision for the future of the human body in relation to technology. A spectrum of at least five options for this evolution exist—what we might call a “spectrum of technohumanity.”\textsuperscript{579} Where we stop on this spectrum will reflect our position on whether the human body is a feature or a bug—whether the human body is a focal point for legal preservation in current form or whether it is merely an antediluvian carbon-based operating system that we need to “upgrade.”\textsuperscript{580}

Different benchmarks along the scale of technohumanity will result in materially different innovation governance models and legal prescriptions. Yet, perhaps the most difficult question of all for law asks how we govern a society in which we do not all agree on the “correct” benchmark on the scale of technohumanity. For this inquiry on social governance and IoB, we can perhaps glean insights from the work of Bruno Latour. Latour’s arguments and their implications for law and social governance will be considered at greater length in the companion essay to this Article, \textit{The Internet of Latour’s Things}.\textsuperscript{581}

\begin{itemize}
  \item be considerable, and no information privacy law at present regulates the terms of such data collection.” Paul M. Schwartz, \textit{Property, Privacy, and Personal Data}, 117 \textit{Harv. L. Rev.} 2055, 2062 (2004); see also Brett Frischmann & Evan Selinger, \textit{Re-Engineering Humanity} (2018) (arguing that humans are being trained to behave like machines); Jannice Käll, \textit{A Posthuman Data Subject? The Right to Be Forgotten and Beyond}, 18 \textit{German L.J.} 1145, 1152 (2017).
  \item The legal literature has not yet explicitly grappled with the issues presented by third-generation IoB to the First Amendment and deliberative democracy in particular.
  \item The spectrum ranges from a model of the mechanically extended human, on the one side, to a model of AI simulation theory on the other. \textit{See} Andrea M. Matwyshyn, The Internet of Latour’s Things (unpublished manuscript) (on file with author).
  \item Paranyushkin, \textit{supra} note 570.
  \item \textit{See} Andrea M. Matwyshyn, The Internet of Latour’s Things (unpublished manuscript) (on file with author).
\end{itemize}
CONCLUSION: THE (CYBER)PANCREAS AND THE PANOPTICON

Cypher: You know, I know this steak doesn’t exist. I know that when I put it in my mouth, the Matrix is telling my brain that it is juicy and delicious. After nine years, you know what I realize? [Takes a bite of steak] Cypher: Ignorance is bliss.582

“This is going to be a thing in the future—people just kind of sitting around and staring at blank walls.”
—Mark Zuckerberg583

This Article has introduced the ongoing progression of the Internet of Things into the Internet of Bodies—a network of human bodies whose confidentiality, integrity, and availability rely at least in part on the Internet and related technologies. First-generation body external IoB devices are already ubiquitous, and second generation body internal devices are arriving presently. Third-generation body-melded IoB devices are currently in development with maturity perhaps less than a decade away.

This Article has argued that IoB devices will suffer from the same categories of security flaws that are currently visible in IoT. However, unlike IoT, IoB technologies will directly, physically harm human bodies and necessitate the evolution of the way that scholars and jurists think about code and the body. A legal paradigm focused on safeguarding Kantian heautonomy as a guiding baseline principle will help mitigate the risk that IoB may corrupt not only individual human bodies but also our body politic.

“I don’t know the future. I didn’t come here to tell you how this is going to end. I came here to tell you how it’s going to begin.”
—Neo584

582. The Matrix, supra note 2.
583. Zuckerberg, supra note 124 (explaining a new Facebook application that allows people to use their phones or other devices to “see” art on blank walls).
584. The Matrix, supra note 2.